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THE MAN-LIKE APES • CHIMPANZEE AND YOUNG



HARMSWORTH NATURAL HISTORY

A COMPLETE SURVEY OF THE ANIMAL KINGDOM

WITH THOUSANDS OF PHOTOGRAPHS FROM LIFE,
AND AN UNRIVALLED SERIES OF COLOUR PLATES

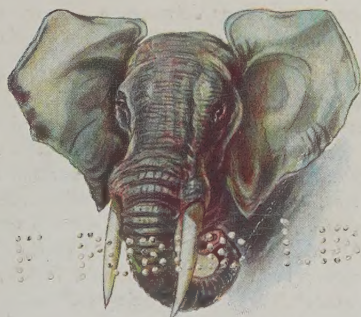


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ABOUT THIS BOOK

THE Harmsworth Natural History belongs to the group of educational publications which includes the Harmsworth Encyclopædia, the Harmsworth Self-Educator, the Harmsworth History of the World, the World's Great Books, and the Children's Encyclopædia. The present addition to this series covers a wide field which, of course, could only be briefly touched upon in any other of these kindred works.

THE Natural History is a popular survey of all living creation as it exists in the world to-day. It may be doubted if so comprehensive a book of Animal Life has ever been offered to the public at a popular price, and it may be confidently asserted that no popular work of this kind has ever before been furnished with such a remarkable gallery of animal paintings as this book contains. The colour plates, about 150 in number, are unique among animal pictures, and the hundreds of black and white drawings by the same famous artist, William Kuhnert, in addition to the photographs from real life—some of them reproduced by direct colour photography, so that we thus have Nature in her own colours—enrich the book with an unrivalled series of illustrations.

IT has been one of the chief aims of the editors to avoid the technicalities which make the conventional Natural History a dull and difficult book to read; and the aim constantly borne in mind has been to make this pageant of animal life in the world to-day as picturesque as pen and brush can make it.

AND yet, of course, this book is not merely a magazine of natural interest, it is an encyclopædia of living things; it has the value of scientific authority and the interest of the story-book as well. If an appeal is made to names, the claim made for this book is that it has behind it the vast experience and learning of Mr. Richard Lydekker, whose name is among the greatest in Natural History. It has behind it the great authority of Prof. J. R. Ainsworth-Davis, whose work has carried his name into every well-equipped library of Natural History in the world. It has behind it not only these two unquestioned authorities, each responsible for a great part of the actual contributions, but the name of Sir Harry Johnston, a man eminently distinguished in many spheres, who writes in this book of wild life in its native haunts, of animals as he knows them.

IT is right that in a work bearing such high scientific authority there should be something more than mere descriptions of animals, beginning as the conventional Natural History begins, with the first class of Mammals; and our book opens with a series of chapters important and interesting enough to make a notable volume in themselves. These chapters bring into the work many other names of great distinction in the various departments of Natural History, and we find among them Sir Herbert Maxwell, F.R.S.; Dr. Alfred Russel Wallace, F.R.S.; Prof. J. W. Gregory, F.R.S., of the University of Glasgow; Prof. C. Lloyd Morgan, F.R.S., of the University of Bristol; Prof. E. B. Poulton, F.R.S., of the University of Oxford; Prof. J. A. Thomson, of the University of Aberdeen; Prof. Turner, of the Royal Agricultural College, Cirencester; Mr. R. I. Pocock, the Superintendent of the Zoological Gardens; Mr. W. P. Pyecraft, of the Natural History Department of the British Museum; Mr. Aubyn Trevor-Battye; Mr. W. H. Hudson; Major F. T. Alexander, and others.

IT is not necessary that any more should be said of a book with such names as these, with such pictures as these, and with such authority as every page in these volumes has stamped upon it.

A. M.

THE PAGEANT OF LIFE

A SURVEY OF MAN'S NEIGHBOURS IN THE WORLD

By Sir HERBERT MAXWELL, F.R.S.

AMONG the fairy stories with which Grimm enthralled the imagination of mid-Victorian childhood, there is none which lingers so agreeably as that which describes the experience of a youth who, I forget by what happy accident or device, acquired the gift of hearing and understanding the conversation of what are commonly, but incorrectly, described as "dumb animals." It would indeed be rash to commit oneself to the statement that any living creature above the rank of a jellyfish is incapable of oral communication with its fellows, or to apply to it the epithet "dumb" in a more literal sense than one addresses an unknown correspondent as "dear sir," or refers to a briefless barrister in the House of Commons as "my honourable and learned friend." It was Alphonse Karr—was it not?—who declared that his dog could do everything except speak, and thanked Heaven that the dear creature could not do that, else he would assuredly have bored his master by repeating the same observation over and over again.

Well, thus far the fairy gift of interpreting the language of beast and bird has been withheld from us; but recent research has given us a clearer understanding of our fellow-inhabitants of the globe by removing some of the mists which still hung round natural history, even after the far-seeing Linnæus had opened our understanding to the leading affinities of animated Nature.

In an early year of the twentieth century the enterprising editor of a daily newspaper addressed inquiry to a number of persons, inviting their opinion as to which English writer had most powerfully influenced the general trend of thought in the century that had just come to a close. Not a question to be answered off-hand, one will see; but, after giving it the consideration it deserved, I wrote without hesitation the name of Charles Darwin. Some there be who will demur to such pre-eminence being given to a mere naturalist over the great theologians, historians, philosophers, moralists, poets, essayists, novelists, and men of science of the later Georgian and Victorian eras, many of whom made enduring impression upon their respective provinces of intelligence; but none of these had to overcome such determined opposition from students in the other departments of human knowledge; none could claim a victory so decisive, or one that was to affect so profoundly the methods and conclusions of workers in widely different fields of intellectual energy.

This is no place for discussing whether Darwin placed correctly every link in the chain of evolution, or whether he laid upon the doctrine of natural selection more stress than it has been since found able to bear. These matters continue, and are likely for some time to continue, to afford material for discussion and even for dispute. What all men

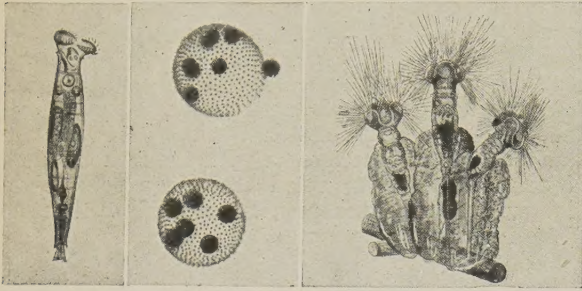
acknowledge is that Darwin, surveying the products of scientific research accumulated by preceding generations, checked some, rejected others, and verified many of them by laborious personal observation, and, having carefully collated with them the result of man's deliberate interference with the reproduction of domestic animals, lifted the whole scheme of biology into a higher plane, presenting animated Nature in a novel and startling aspect.

It cannot be denied that such a revelation administered a violent shock to the ordinary citizen's habit of thought. Those who are old enough to remember events in the early 'sixties will not have forgotten that the new doctrine was authoritatively denounced as incompatible with—nay, subversive of—the Christian faith. It was repugnant even to robust intellects to be asked to acknowledge that man owed descent from a common ancestor with the vermin that preyed upon him—to admit that when "God formed man of the dust of the ground, and breathed into his nostrils the breath of life, and man became a living soul," it was identically the same breath of life that animated all other living creatures. All men felt that if this new teaching were to be accepted, the material world must be viewed from a standpoint very different from that whence their forefathers had surveyed it, and this could not be done without some modification in the established understanding of spiritual things.

Darwin, therefore, had arrayed against him, not only the preconceived theories of renowned biologists like Sir Richard Owen, but also the principles and prejudices of religious men and women, the instinct and sentiment of poets, and the passive conservatism of the mass of his fellow-men. To overcome all these called for more than a mere exposition of conclusions, however logical, founded upon facts, however demonstrable; it required the prophet's fire to burn them into unwilling minds. An article in the "Quarterly Review" for July, 1860, dealing with the "Origin of Species" published in the previous year, condemned it, not without ridicule, as a work "most dishonourable and injurious to science"; yet the writer could not be insensible to the magic of genius, whereby a treatise, of necessity highly technical, possessed all the fascination of a romance.

"We feel," he says, "as we walk abroad with Mr. Darwin, very much as the favoured object of the attention of the dervish must have felt when he had rubbed the ointment around his eye, and had it opened to see all the jewels and diamonds and emeralds and topazes and rubies, which were sparkling unregarded beneath the earth, hidden as yet from all eyes save those which the dervish had enlightened. But here we are bound to say our pleasure terminates."

And now, after the lapse of half a century, none who has given any serious and sustained thought to the problem of existence can regard human life as differing in essence from the vital principle in the humblest animals, or detect a break in the physical continuity between the oyster and the epicure.

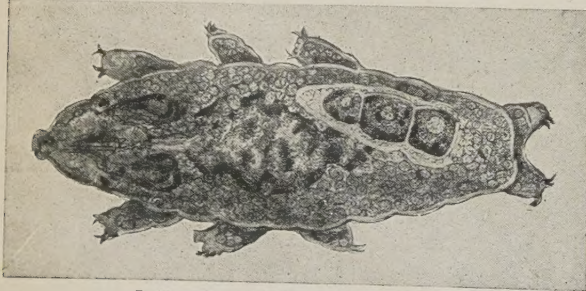


SOME EXAMPLES OF TYPICAL ANIMALCULES

On the left a common rotifer, volvox in centre, and floscularia on the right

Pious men who have been at pains to examine the doctrine of evolution find therein nothing inconsistent with the direction and control of a Supreme Power, and much that seems to postulate the existence of one.

The result, as affecting the ordinary, unscientific lover of Nature, has been to impart a deeper interest to the pageant of life, to give a new significance to the deadly struggle for survival which has been maintained for ages beyond our power of numeration, and to explain the purpose of the merciless suppression of unfit types and individuals. The pageant of life, said I? Nay, but a pageant is only a make-believe, whereas what we witness is actual, never-ending conflict of race against race, clan against clan, with no quarter given or taken. Nor are we, proudly as we claim the lordship of creation, mere spectators of the strife. Never may we lay down our arms; warfare is our lot—defensive war against creatures individually more powerful than ourselves or collectively more injurious, against the agents of disease and against our own kind—offensive war against other creatures, innocuous in themselves, but whose skins and feathers we covet for clothing or their flesh for food. Hordes of captives, too, we keep in bondage, some as slaves for forced labour, some for butchery as occasion serves.



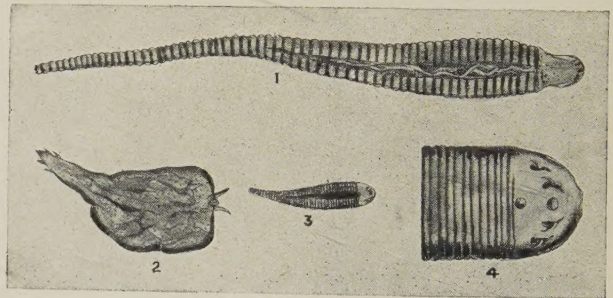
THE SO-CALLED WATER BEAR

This animalcule, here greatly magnified, is less than a twenty-fifth of an inch in size, and yet has a wonderfully developed organism

With respect to individuals, we evade the penalty of unfitness by sedulous provision of hospitals and sanatoria, making successful effort to keep thousands of persons alive who Nature intended should

succumb to disease, and prolonging the lives of others far beyond the natural term by medicine and invalid diet, not to mention such artful devices as spectacles, artificial teeth, and aseptic surgery. But woe betide those races of men which fail to hold their own—American Indians, Eskimo, Veddahs of Ceylon, Australasian aborigines! Unable to adapt themselves to changing environment, they disappear from an unkindly world as surely as the iguanodon of the Cretaceous weald or the hairy mammoth of Pleistocene times.

Ruthless stringency in eliminating the unfit results in the uniform vigour and energy of what we term the lower animals. Epizootics—diseases that from time to time decimate, and more than decimate, the more fecund races of animals—leave the survivors fitter than ever to maintain the struggle, and epidemics among human tribes in a state of barbarism have a like effect. One is apt to recognise in this a teleological purpose, the periodical elimination of a large percentage of consumers in the interest of the survivors and, through them, of the race. It is only in the human community that diseased or enfeebled individuals are permitted to exist and transmit their infirmities to their off-



PENTASTOMIDS, STRANGE AND DANGEROUS PARASITES

1, female; 2, young larva; 3, male; 4, enlarged head of male

spring. When a wild creature loses the power of sustaining itself, the end is not far off. Animals that will freely risk their lives against any odds in defence of their young show the utmost indifference to the evil plight of their fellows, in some cases attacking a wounded comrade and hastening its demise.

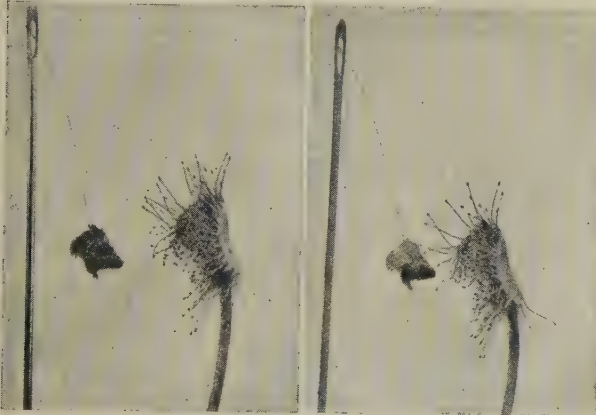
As to life itself, what it is and whence it comes, the most advanced biologists can afford no explanation. Only one principle is universally recognised by men of science—*nullum vivum sine vivo*—"every living thing proceeds from something else that lives." There is no such process as spontaneous generation. Let us accept as the present limit of our understanding the frank confession of Professor Marcus Hartog: "Of the ultimate origin of organic life from inorganic life we have not the faintest inkling. If it took place in the remote past, it has not been accomplished to the knowledge of man in the history of scientific experience, and does not seem likely to be fulfilled in the immediate, or even the proximate, future."

But this much has been ascertained—a fact which has a humbling, though not a humiliating, bearing upon our own self-consciousness—that all the higher

THE PAGEANT OF LIFE

animals, not excepting man himself, are built up of innumerable cells, which are separate organisms, exhibiting all the characteristics of living beings, namely, irritability, motility, digestion, nutrition, growth, and reproduction. We may even go a step further back, and recognise that vegetable and animal life are of common origin and nature, the cells building up the higher plants being mostly isolated in separate cavities connected by slender threads, the higher animals consisting of cells in close and universal contact with each other. These cells, known as Protista, are the most primitive form of life known to science; they are the common source whence proceed the two great rivers of life—the animal and the vegetable.

It is only within recent times that modern appliances and research have brought to our knowledge how life in one form or another pervades every spot in this globe that is capable of sustaining it. It exists even under conditions which might excusably have been pronounced incompatible with



THE SUNDEW, A FLESH-EATING PLANT

On the left the sundew is bending towards a piece of meat; on the right it has reached the food and is about to fasten on it

it. Mr. James Murray, biologist with Sir Ernest Shackleton's Antarctic expedition, sank a shaft through fifteen feet of solid ice to the bottom of a coastal lake, and brought up swarms of rotifers and water bears (Macrobiotus). Now, this lake never thawed during the two summers which the explorers spent there; it may have been frozen solid for years or even for centuries, during which these creatures had been embedded in a temperature of forty degrees (Fahrenheit) below zero, incapable, of course, of discharging any of the functions of life. Yet no sooner were they brought to light and placed in water than the rotifers began scooping in floating atoms of food, and they, as well as the minute rhizopoda and water bears, set about at once the process of reproduction, either viviparously or through egg-laying.

Now, these microscopic creatures are far removed above the lowest forms of life. The so-called water bear, for instance, has a simple, but segmented and perfectly symmetrical structure, the sexes of individuals being distinct and separate. It has eight legs, armed with effective claws, teeth hardened at the tips by a calcareous deposit, a blood fluid containing numerous corpuscles, a stomach,



THE VENUS FLY-TRAP, AN INSECT-EATING PLANT

The teeth of the leaves close with a snap and imprison the insect in the trap

a brain and nervous system, an alimentary canal, an excretory orifice between the hindmost pair of legs, sometimes a pair of eyes, but never a heart. Although it never exceeds one millimetre in length ($25\frac{1}{2}$ millimetres = 1 inch), it is the host of many bacteria which infest its blood.

Of all segmented animals, macrobiotus, or the water bear, is the most widely distributed, some species inhabiting water, but the greater number moss, every tuft of which swarms with them. Moisture is essential to their active existence, but if that fails, the animal dries up into what appears to be a grain of sand. In this condition it may remain for years; but the vital spark is not extinct. Moisten the atom, and it becomes plump and pliant once more, resuming its normal functions and interrupted pursuits as if nothing had happened. Wherever a scrap of moss manages to maintain existence on the desolate Antarctic rocks, Mr. James Murray found it to be the harbour of this lowly race. Often the moss and its inhabitants were only thawed into life for two or three hours on a few days at midsummer,



THE PITCHER PLANT, OR NEPENTHES, AN INSECT-EATER

On the left some flies are shown about to enter the pitcher; on the right is seen a section of the pitcher, containing the dead flies

being frozen hard again each night, and remaining hard-frozen night and day for 350 out of 365 days.

No man need blush to own macrobiotus among his "poor relations," for there does not exist a more harmless race than these minute creatures, which prey—upon nearly all forms of life prey upon other forms—only upon mosses and algæ, nibbling through the cell-walls of these humble forms of vegetation and imbibing the sap. But one cannot without a shudder recognise affinity with another class of animal, not distant of kin from the gentle water bear, suggesting the fancy that there have been two creative agencies at work—one, a benignant Deity, designing channels through which the vital force shall be moulded into more perfect beauty and nobler form; the other, a malignant demon, intent upon devising subtle and corrupt instruments for defacing, maiming, and destroying the handiwork of the rival Power. The life-history of the pentastomids (see page 2) shows how the perpetuation of every living animal involves the affliction, and often the sacrifice, of some other form of life. These pentastomids are loathsome creatures, inhabiting the nostrils or lungs of dogs and other carnivorous animals. Their eggs or larvæ, being expelled by coughing or sneezing, fall on grass or other herbage, and depend for development upon being swallowed by some browsing creature.

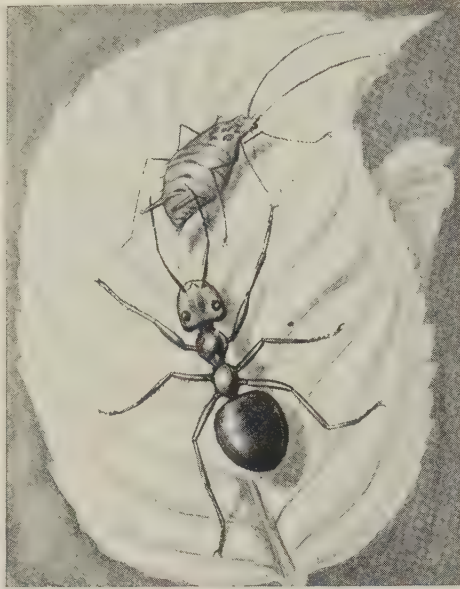
When this happens, the larva, which is furnished with clawed limbs, bores through the walls of the stomach, and penetrates to the liver or some other principal organ, where it ensconces itself for several months. As the time for assuming its adult form approaches, the creature begins wandering through the tissues of its host, sometimes causing dangerous, and even fatal

disturbance. If the said host—be it sheep, deer, rabbit, or what not—is devoured by a dog or other beast of prey, the larva, when swallowed, travels into the lungs or nasal cavity of its second host, where it awaits its development into an adult, and the unlovely cycle is renewed. Note, by the by, that pentastomids are quite distinct from the cestodes, or tapeworms, which they greatly resemble in haunt and habit. The cestodes are far lower in the scale of animated Nature than the pentastomids, being hermaphrodite, destitute of a digestive tract, and absorbing nutriment by soaking in the dissolved food in the intestines of their host; whereas the pentastomids are bi-sexual, the males moving about freely in quest of their mates, and live by sucking blood from the internal organs wherein they have acquired lodgment.

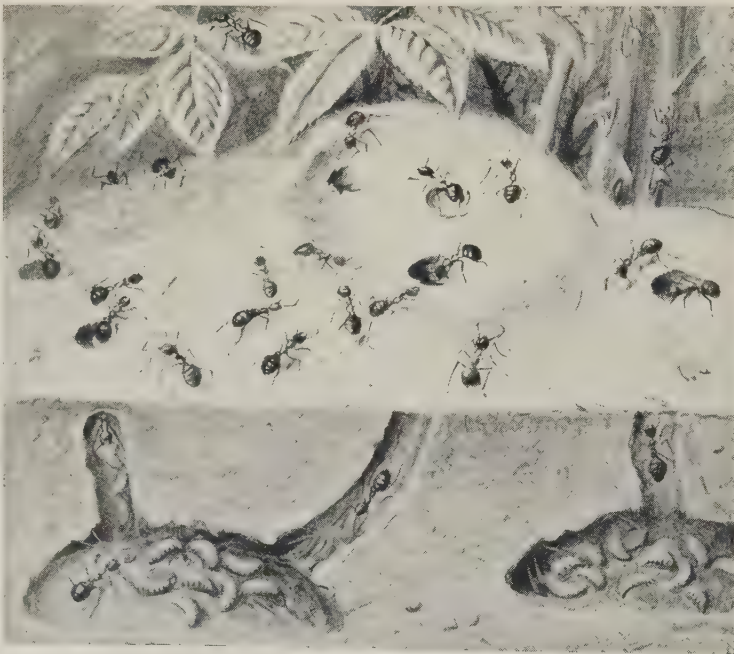
Such are some of the sordid and revolting passages in the pageant, inseparable from the unity of its design; whereof, if one would have clear understanding, he must not shrink from accepting the stern truth that it is based upon universal rapine, and that no animal, from man down to macrobiotus, and lower, can exist save at the expense of other creatures.

It is vain to appeal to Holy Writ against this doctrine. "Behold now behemoth . . . he eateth grass as an ox." True it is that the hugest terrestrial mammals—elephant, rhinoceros, hippopotamus, and so on—are vegetarian in diet; but the herbage and foliage whereon they subsist would be useless to them were it not alive or had it never lived. Animal and vegetable life being fundamentally identical in their

origin, every modern textbook of zoology must take account of certain primitive forms of vegetation—Protophyta—because it has not been



AN ANT MILKING AN APHID



THE COMMUNAL LIFE OF THE ANTS

An ant-hill showing insects emerging from and returning to their quarters. In the section of the nest are seen some ants waiting on the larvæ, which are diligently nursed and tended

possible to define a frontier between them and Protozoa, the most primitive forms of animal life. Plants must be regarded as beings, animated by a motor force indistinguishable from that which permeates the frame of the mightiest monarch and the meanest mollusc; but, in obedience to their prescribed nature, they build themselves into cell-

walls, forfeiting the power of locomotion. Having neither mouths nor stomachs, they receive nutrition by absorption instead of prehension; but they have a power denied to animals—namely, that of converting mineral and chemical substances into food; whereas animals can only derive nutrition from proteids—that is,

organic compounds of carbon, nitrogen, hydrogen, and oxygen prepared for them by the mediation of vegetable growth. An ox grazing in a meadow receives its proteids direct from the laboratory. Man, as his dentition indicates, was designed to do likewise by consuming fruit and grain; but the possession of a restless brain and supple fingers soon made him impatient of spending more than half his waking hours in eating; he got into the habit of employing humbler animals to do the browsing, gnawing, and crunching for him, and, by devouring their flesh, received a supply of proteids in concentrated form, thereby economising much valuable time. Nevertheless, when he consumes flesh as a staple instead of a supplementary diet, he does so at the cost of liability to certain forms of disease which are often induced by too nitrogenous food.

The chain connecting the human consumer with the vegetable laboratory may consist of many links, each one being a separate act of rapine. Suppose one making a supper of stewed eel. The eel is not known to eat any vegetable; very likely it has been living on spawn deposited by a salmon. The salmon has spent the summer devouring herrings, which, in their turn, have accounted for billions of crustaceans, which may have been the ultimate agents in extracting proteids from vegetable matter, though perhaps they made their prey of still humbler organisms which were vegetarian feeders.

The vegetable kingdom is capable of reprisal upon animals, not merely in the vindictive sense of poisoning them, but by making them their prey.

Bacteria, which are a humble form of vegetable life, are the direct agents in many, probably in most, forms of acute disease. Also, several of the more highly organised plants retaliate upon animals by catching them and absorbing their juices for their own nourishment (see page 3). One of the most highly specialised of these plants is the North

American *Dionæa*—Venus's fly-trap—of which the leaves are longitudinally hinged with three sensitive hairs on each segment. Let an insect but touch one of these hair triggers, the two segments close with a snap, the marginal teeth interlock, and when that leaf unfolds again, nothing remains of



SLAVE-DRIVING ANTS MAKING A RAID UPON ANTS OF PEACEFUL SPECIES

the unlucky trespasser but a pair of wings and an empty skin. Several native British plants are bloodsuckers—the common sundew of moorland bogs, the innocent-looking butterwort, and the crafty little *Utricularia* with its floating bladders, each with a trapdoor standing invitingly open until some tiny creature is tempted to enter, when the prison door closes smartly, and that insect or crustacean goes forth no more. Pitcher plants, several species of arum, and many others, extract and assimilate the juices of insects, which they are specially constructed to attract and detain for their sustenance.



THE ANT-LION SNARING ITS PREY

It is not for man the omnivorous to condemn the furtive devices of plants applied to so practical an end, but it is difficult to discern the motive of certain plants which, by their scent or colour, attract flying insects and slay them, without deriving any advantage from their death. There stands in Lord Ducie's garden at Tortworth Court, Gloucestershire, a specimen of *Tilia petiolaris*, a species of lime-tree, the flowers of which attract thousands of bees and dipterous flies, and kill them in such quantity that there is a distinct ring of rank grass corresponding to the circumference of the branches where the ground has been fertilised by the dead bodies.

Londoners may see in Kew Gardens a large specimen of this tree, which, it need hardly be said, acts in the same deadly manner.

Beekeepers must avoid planting the African torch lilies—commonly known as red-hot poker—near their hives, for the honey of these brilliant flowers intoxicates the bees so quickly that they perish.



THE LIFE HISTORY OF A DRAGON-FLY FROM LARVA TO FLY

Photo. A. Forrester

1, larva in the water; 2, larva climbing stem of plant; 3-5, gradual emergence of the imago, or perfect fly; 6, the fly spreading its wings for its first flight

Howbeit, life is not all ferocity. Killing is the universal means of subsistence—the system prescribed for the maintenance of the myriad actors in the pageant; but in tracing upwards the development of living creatures from primitive and relatively simple forms one arrives at a point where more amiable traits begin to manifest themselves, ultimately affecting the habits and behaviour of the higher animals as powerfully as the craving for food.

It was said by Linnaeus that "Nature is most marvellous in the smallest of her creatures." In no class of animals does one realise the truth of this so forcibly as among the insects. More numerous in their species than all other land animals put together, insects are usually diminutive in size, the largest of

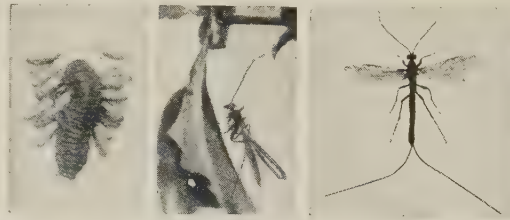
years since King Solomon urged his readers to consider the ways of the ant, but our knowledge of those ways is still very fragmentary, though the various races of ants have been ingeniously classified, and a full description of their structure, physiology, and nutrition may be found in any handbook. What has been ascertained about their social organisation cannot but stimulate our desire to learn more, for the industry of ants is not only incessant, it is of amazing range and variety, comparable only to the organised activity of a human community (see page 4).

The ants that keep herds of aphids, tending them with the utmost care, and milking them (see page 4) of that sugary fluid beloved of ants, are more than mere herdsmen or cowboys; they are skilful stock-

breeders. Every autumn they carefully collect the eggs of aphids, storing them in the ant-hill through the winter, and when the larvæ are hatched in March, they take the little things out and place them on the appropriate food-plant, to be milked in due course when they reach the adult stage. Well may Lord Avebury write of this as "a case of

prudence unexampled in the animal kingdom."

Even more remarkable as an example of foresight, involving a mental process indistinguishable from reason, is the industry of the leaf-cutter ant of Central America. A colony of these, having tunnelled a subterranean passage for many hundreds of feet from the nest to the tree which they have marked out for stripping, send out troops of cutters and carriers, which bring the whole of the leaves into the nest, and hand them over to another set of workers. These chew the leaves into pulp and store them; the mycelium of a certain fungus begins to spread throughout the mass, which they prune carefully to induce it to throw out white nodules,



THE ICHNEUMON FLY

On the left is a caterpillar from which ichneumon larvæ emerge; in the centre is the ophiion ichneumon, and on the right the long-tailed ichneumon. Photos by B. Hanley, D. English, and W. P. Dando

them not exceeding the smallest of birds in bulk; yet it is in this group of invertebrate creatures, individually so insignificant, that one first encounters that passionate solicitude for offspring which ranks so high as a virtue in every human code of ethics. Also, leaving man out of account, it is almost exclusively among insects that co-operative communities are to be found, with complete systems of governance and subdivision of labour. Many vertebrate animals are gregarious, but these are merely sociable, not social. Some of the hunting creatures may combine for attack, but instances of deliberate co-operation, such as the construction and maintenance by beavers of a dam for the good of the colony, and, by the weaver birds, of a common roof for their crowded nests, are difficult to find.

Everybody knows something about the honey bee, and understands something about the perfect manner in which the inhabitants of a hive are divided into classes, each having its structure specialised for definite duties. It is nearly 3,000



SIMPLE SEA SQUIRT AND LARVA COLONIAL SEA SQUIRTS (ARROWS INDICATE THE WATER CURRENTS) BALANOGLOSSUS

THE PAGEANT OF LIFE

instead of the conidia and spores which would appear if the fungus were left alone. These white nodules form the food of the colony.

Some species, like the European rufescent ant, have given up honest work, if indeed they were ever capable of it, and live by slave-driving. It is exactly one hundred years since François Huber described a raid by an army of rufescents which stormed a nest of the ash-coloured species and carried off all the larvæ and pupæ to rear them as slaves (see page 5). The rufescents are splendid fighters, formidably armed, but they have become so dependent on slave labour that they cannot even clean and feed themselves, much less construct their own dwellings or rear their young. When deprived of the services of their slaves, these doughty warriors quickly perish of starvation.

It was the practice of the old school of biologists to attribute to instinct such actions among the lower animals as appeared to anticipate or reflect some of the organisation and occupations of human society. This was satisfactory enough, so long as people did not press too curiously for a definition of instinct as an agency apart from reason. The absence of any such definition makes it difficult to regard these disciplined hordes as faultless automata, devoid of volition; nor may one lightly dismiss the conclusion arrived at by Lord Avebury after a prolonged series of characteristically patient experiments and close observations—namely, that the mental powers of ants and other co-operative insects "differ from those of men not so much in kind as in degree."

The social ants, bees, and wasps among the Hymenoptera, as well as the termites (so-called white ants) among the Neuroptera, are passive in the care of nurses during their larval and pupal stages; it is strange, therefore, to find that one of the deadliest insect enemies of ants is the larva of a neuropterous fly, the fly itself being perfectly harmless to them. This formidable larva, which is popularly known as the ant lion, marks out with its body a circle in dry sand, within which it digs a pitfall, throwing out the sand by jerking its broad head. It then buries itself at the bottom of the trap and waits until an ant, hurrying along on business intent, trespasses on the shifting slope of the pit. No nightmare can exceed in horror the fate incurred by that hapless insect. The monster, lurking below with wide-set eyes, flings showers of sand upon its victim, till it brings it within reach of its cruel jaws (see page 5).

It is pleasant to turn from contemplating the murderous proceedings of insects like these to enjoy the beauty of the Lepidoptera—the butterflies and moths—which, if as larvæ they exact a heavy tribute of living vegetable tissue, amply repay the debt in their perfect state by fertilising visits to flowers. No summer day is at its best without the fluttering of their jewelled wings. One might think that such exquisite beauty should be their warrant against persecution. But Nature cannot allow caterpillars to multiply unchecked, wherefore she has provided a special constabulary in the shape of about 6,000 species of ichneumon flies, of which some 1,200 species are native to Britain. Most kinds of ichneumon

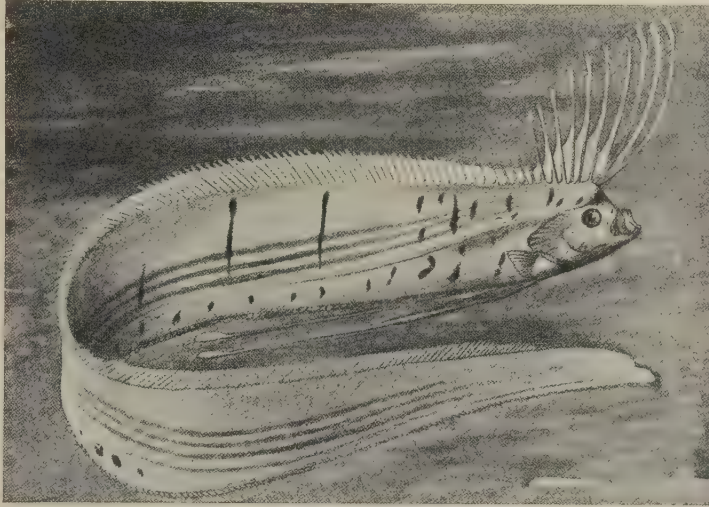
flies set about business in a singularly repulsive way. The female thrusts an egg into the body of a caterpillar, cocoon, or chrysalis, whence is hatched a maggot that gradually eats up the tissues of its host, turns into a pupa, and finally issues as a slender hymenopterous fly (see page 6).

Insects, in the opinion of Mr. David Sharp, must be regarded as the most successful of all the forms of terrestrial life, but very few of

them find water a congenial home. It is true that very many flying insects pass their larval stages in shallow, fresh water; and the metamorphosis from a water-breathing larva to an air-breathing insect is one of the most remarkable processes in Nature, being instantaneous (see page 6); nor did the transformation escape the trained vigilance of Tennyson, who wrote:

To-day I saw the dragon-fly
Come from the wells where he did lie;
An inner impulse rent the veil
Of his old husk, from head to tail
Came out clear plates of sapphire mail.
He dried his wings: like gauze they grew;
Through crofts and pastures wet with dew
A living flash of light he flew.

Of all the myriad forms of life with which the ocean swarms, only very few kinds of insects succeeded in establishing themselves therein; but their absence is amply balanced by innumerable species of crustaceans, some of which people the waters of Polar seas as densely as swarms of locusts do the air. It is in the sea, moreover, that Ascidians, or sea squirts (see page 6), and their allies abound, presenting the first hint of a backbone in the shape of what is termed a notochord. They appear to be an intermediate form, possibly degenerate, but perhaps only arrested, between the worms, or other type of invertebrate animal, and the vertebrates. One of the



THE MYSTERIOUS OAR-FISH, WHICH ANGLES FOR ITS PREY

most remarkable forms of marine life is the balanoglossus, which studs the sand with worm-like castings. Nothing could be less suggestive of a backboneed animal than these slimy creatures which most people would assume to be a kind of marine earthworm. Yet in these Hemichordata, so called because a notochord extends for half their length, must be recognised a direct descendant of extinct ancestors from which all the vertebrates trace their lineage.

Passing them by, we come to the fishes, earliest of all animals to develop a vertebral column, with its indispensable supplement—a head. No class of living creature is so generally carnivorous as the fishes are. Very few

species content themselves with vegetable fare. From the lustrous salmon, ideally modelled for swift energy, to the hideous and sluggish angler or fishing frog, nearly all spend their lives in hunting or being hunted to the death. The blue shark, with its terrible armature of cutting teeth, and the still larger and more formidable Rondeleti's shark differ from the trout and minnows of the babbling brooks only in the relative size of their victims.

Low as fishes rank in the scale of vertebrates, some exhibit in their habits striking analogues to the inventions of man. Most species take their prey by hunting; others are adept anglers, notably the king of the herrings, or oar-fish (see page 7), that mysterious denizen of abysmal ocean which there is reason to identify with the sea-serpent. The ventral fins of this great fish, situated close under the throat, are each reduced to a single, long, and flexible ray tipped with an attractive crimson tag, and with these rods and baits Regalecus—to give the creature its scientific name—lures small fry within reach of a pair of serviceable jaws. The angler or fishing frog, the "wide-gab" of Scottish fishermen, buries its huge carcase in the ooze and lies in wait for fishes attracted by the baits displayed on its long dorsal rays. Then there is the archer fish, *Toxotes jaculator*, of Oriental rivers, which aims jets of water at insects on the bank, or on overhanging foliage, with such true aim as seldom to miss the mark. The invention by man of the electric battery has been anticipated in three genera of fishes—the electric

rays in both the Atlantic and Pacific Oceans, the electric catfish of African rivers, and the still more formidable gymnotus of the Orinoco, all of which employ this marvellous force at will, whether in self-defence or to disable or kill their prey.

Although the majority of fishes bring the cares of reproduction to a close with the act of spawning, many species have developed traits of higher intelligence by sedulous attention to nest-building, incubation, and attention to the fry when hatched. The pretty little gunnel, or butterfish, of the British coasts and the common stickleback of brooks and ponds are well-known exponents of domestic virtue,

and among exotic fishes may be mentioned the huge Australian barramunda, some of the catfishes, the South African lepidosiren, the North American bowfin, and the freshwater bass.

From the fishes, or at least from fish-like, water-breathing ancestors with fins and internal gills, were derived in a remote age the amphibians, provided with four limbs and external gills, either temporary or permanent, as well as internal lungs, and these in turn were the progenitors of the reptiles. Both these classes have fallen upon evil times; our globe is no longer the congenial home it was for animals with their special requirements, and their modern representatives have dwindled from their pristine importance. Many races of amphibians have disappeared; those that remain—frogs, toads, newts, and the like—deserve more than passing regard, for among their ancestry of the Carboniferous Age we recognise the earliest ap-

pearance on earth of four-footed creatures with five-fingered limbs, a structural design appropriated later for the higher mammals, including man himself. Indeed, a fossil labyrinthodon from the Upper Miocene, in Switzerland, was hailed by Scheuchzer in 1726 as the skeleton of antediluvian man, and remained labelled to that effect in the Haarlem Museum until Cuvier proved it to be a gigantic newt.

By imperceptible stages the amphibians pass into the class of reptiles—the only cold-blooded animals breathing by lungs alone. These likewise have been forced by changing terrestrial conditions to surrender

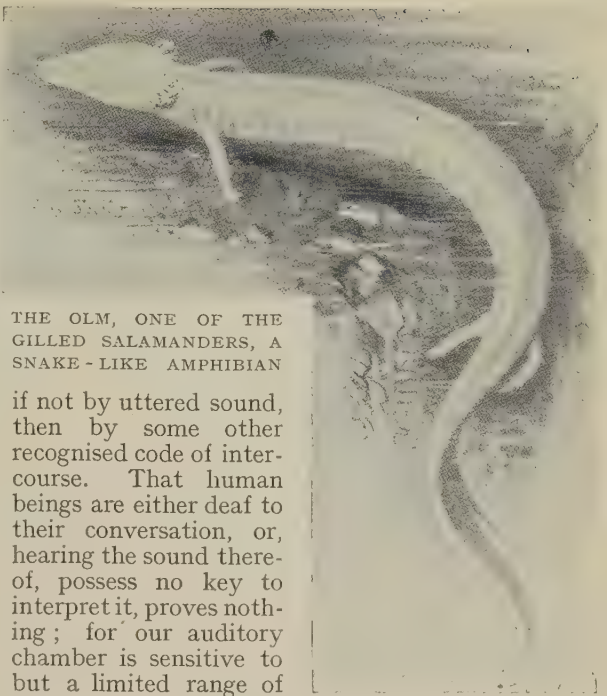


THE ARCHER FISH SHOOTING WATER AT A FLY

the supremacy they enjoyed when the world was still young; for although crocodiles and pythons yet make a respectable appearance in the Eastern hemisphere, and alligators and anacondas retain their places in America, they are all mere dwarfs compared with the ponderous dinosaurs which dominated the Mesozoic land. Indeed, if we leave aside the question between exoteric or inspired intelligence and esoteric mental evolution, there are some grounds for suspicion that, had the climate of this globe remained as it was when the lower Cretaceous beds were laid down, man would never have been in a position to claim the lordship of creation, and that the sovereignty would have been usurped by a reptile. Note, by the way, that it is recorded in Holy Writ that the serpent "was more subtle than any beast of the field." Dr. Robert Munro recognises the erect posture of man as one of the chief factors in his "subtlety," that is, in his mental ascendancy over other creatures. No other creature is exempt from the necessity of using its anterior limbs primarily for support and locomotion; only in man have they been set free for manipulative industry. From what was once only a forefoot has been evolved the most perfect and most complex prehensile organ hitherto produced by Nature; so perfect a servant of the will stimulates the brain, the brain responds by setting the hand to fresh tasks, and so hand and head perpetually react one upon the other, their energy being endless.

Now, the iguanodon of the Wealden Clay was an enormous lizard some thirty or forty feet long, walking on its hind legs in a posture as nearly erect as was consistent with carrying a long and heavy tail clear of the ooze. Fortunately for the prospects of man, iguanodons were starved or frozen to extinction before the freedom of their five-fingered hands could stimulate their brains to a sense of the possible destiny of their race; and nowadays the only existing reptile that is known to resort to biped locomotion is the Australian frilled lizard, a strange little being that tries to frighten away assailants by making hideous grimaces at them.

Anybody who has closely observed the behaviour of animals among themselves can scarcely doubt that they are able to communicate with each other,



THE OLM, ONE OF THE GILLED SALAMANDERS, A SNAKE-LIKE AMPHIBIAN

if not by uttered sound, then by some other recognised code of intercourse. That human beings are either deaf to their conversation, or, hearing the sound thereof, possess no key to interpret it, proves nothing; for our auditory chamber is sensitive to but a limited range of sound. There are many persons who have never heard so high a note as the squeak of a bat. Depend upon it, the sounds we hear wild animals utter, and many that they utter which we do not hear, are not mere noise; they are charged with significance.

The pageant has not been altogether silent up to this point; crocodiles grunt or bark, frogs croak, many fishes possess and exercise sound-producing organs; but not hitherto has it been enlivened by a single note of music. With the advent of the birds, however, the air soon becomes vocal; not very musical at first, for birds are but modified reptiles, and long ages had to elapse before they could bring themselves to discard teeth. Of all forms of wild animals, birds assuredly have found most friends and admirers among human bipeds. Their attractive forms and conspicuous behaviour, their ingenuity as architects, their exemplary care for their young, and, perhaps most of all, their loquacity, which, in many species, develops into a unique faculty of melody, have endeared them beyond all other creatures to all who have eyes to see and ears to hear withal.

It is unfortunate that affection for birds should manifest itself so generally by imprisoning them, thereby depriving them of the exercise of that faculty which is their chief glory, the power of flight—a faculty which man from earliest time has envied and applied all his ingenuity to emulate, hitherto with remarkably indifferent success. If birds be gifted with a sense of humour, what amusement must be provided to such masters of wingmanship as the swift and the falcon by the ponderous and noisy contrivances with which our most daring aeronauts manage, or fail to manage, a precarious transit of a few miles through mid-air!



FROGS AT PLAY ON THE BANK OF A POND



A FRILLED LIZARD RUNNING ON ITS HIND LEGS

The trade in cage-birds is a sorrowful subject of contemplation for humane persons, so high is the rate of mortality among the captives, and so inevitably must the survivors suffer from confinement and want of exercise. To realise the necessity of physical exercise to the health of all birds, one need but examine the daily habits of two extreme types. The albatross, with its solid weight of twenty pounds or more, sustained by a wing-spread of twelve or fifteen feet from tip to tip, will sail in wide circles round a ship, through rough weather and fine, for many days and nights without once alighting to rest. Does the bird remain awake all the time, or was Tom Moore right in referring to its "cloud-rocked slumberings"? If it sleeps, how does it steer a course? Professor Hutton has, rightly no doubt, explained that this bird's soaring flight is automatic, "combining, according to the laws of mechanics, the pressure of the air against his wings, with the force of gravity"; but he seems to be wrong when he adds that "by using his head and tail as bow and stern rudders, the albatross is enabled to sail in any direction he pleases, so long as the momentum lasts." This suggests an initial momentum from wing-strokes, whereas the propelling force is continuous, produced by air-pressure on the wing-spread caused by the weight of the creature's body. Moreover, it is neither by head nor tail that the albatross steers, but by altering the plane of its wings.

In contrast to the majestic sailing of the albatross, consider the incessant diurnal activity of the smallest British bird—the gold-crested wren—a mite weighing about one ounce and measuring three inches and a half in length. That excellent ornithologist, George Montagu, moved into his study a nest containing eight young gold-crests, without interrupting the attentions of the parent birds to their brood. Closely observant, he ascertained that the little mother visited the nest on an average of more than once in every two minutes during a summer day of sixteen hours, thus making about 550 trips in the day. Allowing, on a moderate estimate, that she did not travel more than 100 yards in each trip, her day's journey amounted to 31 miles,

a distance exceeding the traveller's stature 622,614 times; and this was performed on ten days continuously. The equivalent for a man of six feet high would be a daily march of 707 miles, in the course of which he must collect and distribute food among his children, besides spending time and energy in keeping the nursery scrupulously clean.

The elucidation of such a fact in the life-history of a wild creature is of infinitely greater importance to natural history than any contribution likely to be made by a mere bird-fancier, who, whatever care and affection he may bestow upon his favourites, must act primarily as their gaoler. One undertaking to study human nature will

not succeed best by confining his observation to prisons and penitentiaries; he must frequent scenes of free and busy social life.

Systematists hold that the modification of reptiles into birds bridged a narrower gap than that dividing any other two classes of vertebrate animals; nevertheless, the change from cold-blooded creatures to those which, like birds, have a blood-temperature several degrees higher than that of man is a remarkable one. Certain it is that no class of creatures presents a more varied or more attractive subject for observation than do the birds. No animals exceed some of them in devotion to their young, or exhibit more dauntless courage in defending them. Intrepid human hunters go far afield to match themselves against big game, but where is the sportsman who will venture unarmed to encounter a creature 112 times his own bulk? Yet on a day in last summer that was the exploit of a cock partridge, which flew at a friend of mine, and continued to peck violently at his boot until the mother bird had collected her brood and led them away to safety.

The colouring of birds commands admiration, not only for its range between the sable of the raven and the spotless candour of the swan, with every conceivable combination of iridescent or pigmentary hues, but also for the beauty and structural complexity of the plumage on which it is displayed. One may see yon fellow cleaning out his pipe with the tail-feather of a pigeon or the pen-feather of a gull, without bestowing a thought on the delicate adjustment of interlocking hooks that unite the fibres into a firm, elastic web.

Except among the falcons and hawks, the male usually has the advantage in size and brilliancy of plumage. The office of incubation being generally discharged by the female, it is important for her safety that her colouring should assimilate to her immediate environment. So closely do these correspond that it is commonly the bright eye of a sitting grouse, partridge, or ptarmigan that betrays the nest to a passer-by. In some families, however, the male bird takes exclusive charge of the nursery, and dresses for the part. Thus in the *Eclectus* genus of parrots, inhabiting the Moluccas and the Solomon

THE PAGEANT OF LIFE

Archipelago, the females are usually attired in gorgeous scarlet. They lay their eggs, and, leaving their mates to hatch them, fly away to disport themselves in their fine raiment. The dutiful husbands, on the other hand, wear protective green plumage, nicely matching the foliage round the nest. It may further be mentioned that in this genus the disparity of the sexes is so extraordinary that they were at first classed as belonging to separate species.

We have loitered so long on the upward course of our pageant as to leave little time for noticing the highest group of vertebrate animals—namely, mammals, or creatures which suckle their young through teats, or exceptionally, as in that strange egg-laying mammal the duck-billed platypus, which nourish their young in a mammary pouch. The link connecting mammals with the reptilian vertebrates still awaits elucidation, although Professor Seeley has shown how closely the dentition of the fossile Theriodonts, an extinct group of large reptiles, approaches the characteristic specialisation of mammalian teeth.

In proportion as living organisms rise in the scale of being do they part with their plasticity, yet no class of animal has shown greater adaptability to environment than has the mammalian. Every acre of land capable of yielding vegetable food, and thousands of square miles, especially in Polar regions, which yield none, have been peopled by warm-blooded, more or less hairy, quadrupeds; although man, the highest mammal, has exterminated some species and greatly reduced the multitude of others. So rapidly did mammals increase, when they obtained a footing on the earth, that the land proved incapable of sustaining them all. A branch of the Insectivora—that great order of which the hedgehog, the mole, and the shrew-mouse are British representatives, being in danger of being crowded



A MOTHER PARTRIDGE PROTECTING HER BROOD

out, took to themselves wings and founded a new order—Chiroptera, or bats—which subsist by aerial hunting. The ocean would seem a most unsuitable home for creatures unable to inhale the free oxygen in water, yet it once swarmed with enormous mammals—whales, walrus, dolphins, porpoises, seals; and even now, after men have been working destruction for centuries upon these marine herds, there still roams in the sea the most gigantic of living animals—Sibbald's rorqual, or blue whale, attaining a length of upwards of 85 feet. Longer creatures than this have trod the earth in the past—*diplococus Carnegii*, for instance, which, from nose to tail-tip measured 120 feet—but none has ever equalled the rorqual in bulk.

By a remarkable coincidence, the two creatures which were the last to own the supremacy of man are respectively the largest and well-nigh the smallest that have come under his dominion—namely, Sibbald's rorqual and the pestiferous mosquito. The rorqual was the only animal in the world which no man, not even the most intrepid whaler from Dundee or Bergen, dared to attack, until the invention a few years ago of bomb-harpoons fired from a gun. But now this giant of the deep is hunted as diligently as any other whale, and its extinction may be not far off, for whales reproduce themselves very slowly. The mighty rorqual never did injury to the human race; the slenderest antelope could not be more innocent of offence; but the other creature which set man longest at defiance—the malarial mosquito—is accountable for more human mortality and suffering than all the beasts of prey that ever roamed the world.

By these crowning examples of the supremacy of mind over matter, the ascendancy of man over his fellow-denizens of the globe has been raised to the highest pitch hitherto attained, and with them the pageant of life, as now revealed to us, may be brought to a fitting close.

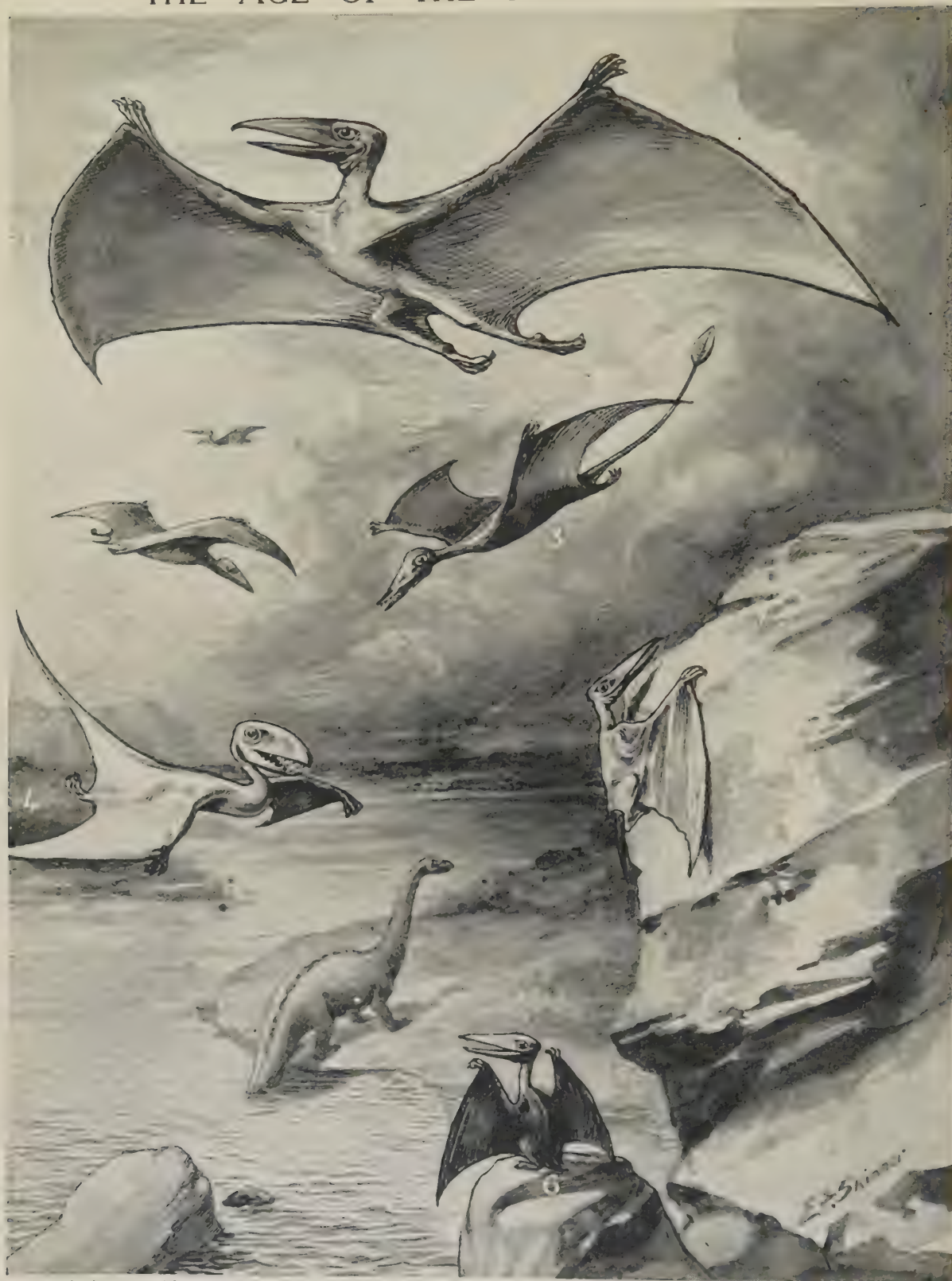
HERBERT MAXWELL.



A FRILLED LIZARD GRIMACING

Photographs by W. P. Dando

THE AGE OF THE FLYING REPTILES



The artist has grouped in this striking picture some of the extinct winged reptiles whose formation may be imagined from their existing remains. 1, *pteranodon occidentalis*; 2, *pterodactylus crassirostris*; 3, *rhamphorhynchus*; 4, *dimorphodon macronyx*; 5, 6, small *pterodactyles*

THE FIRST INHABITANTS OF THE WORLD

MASTERS OF THE EARTH BEFORE THE RISE OF MAN

By Professor J. W. GREGORY, F.R.S.

OUR knowledge of the former inhabitants of the earth is derived from those remains of animals and plants which are found in the rocks of the crust and known as fossils. We can only expect to find fossils in such materials as sand, sandstone, clay, and limestone that have been deposited in layers on land or in water. Such rocks as granite, lava, and statuary marble, that are composed of crystalline constituents, were either molten and solidified under conditions far too hot for the existence of life, or else, as in the case of marble, the rock has been so altered that any traces of life that may once have existed have been destroyed. Fossils, therefore, come from the rocks formed by the deposit of grains of sand and particles of clay, which, as they fell, buried the remains of animals or plants; and also from rocks, such as limestone, which, as we shall see presently, are composed of fossil shells or skeletons.

Accordingly, it is natural to turn to the oldest known rocks that could contain fossils in order to learn from them what were the first living creatures of which we can expect certain knowledge, and the nature of the climate and the geographical conditions under which they lived. Many of these old rocks have undergone such slight alterations that if animals with thick shells had been laid down in them, the fossil remains would certainly have been discovered. The oldest sandstones of the British Isles, the Torridon Sandstones of North-Western Scotland, are so little altered that they were for long regarded as part of the Old Red Sandstone, which is famous for its well-preserved fossil fishes, shells, and ferns. The Torridon Sandstone, however, has hitherto yielded no recognisable fossils; but life was present at the time of its formation, as it contains grains of phosphate of lime which retain traces of organic structures. In North America, around Lake Superior, in Scandinavia, and in South Africa, there

are immense beds of sandstone, of approximately the same age as the Torridon Sandstone, but they also have yielded no fossils. In Montana, however, some beds of this age have furnished a few ill-preserved fossils, including a crustacean known as *Beltina*, and these are the oldest known animals.

The rocks formed before the Torridon Sandstone and its contemporaries extend as a thick series that serves as the foundation on which all the later fossiliferous rocks have been laid down. As these underlying or "Archæan" rocks are composed of crystalline materials, it is not surprising that no fossils have been found in them; but they offer some evidence of the possible existence of life on the earth at the time they were deposited.

Most limestones are formed by the action of plants or animals which extract lime from water, and use it to make their skeletons or shells. It is true that

some limestones have been formed chemically, but those due to living agencies are by far the more abundant; hence many geologists have believed that the thick limestones associated with the old crystalline rocks indicate the probable existence of living beings on the earth when they were deposited.

Again, graphite, a mineral composed of carbon, is abundant in these old crystalline rocks; and carbon, where found in the sedimentary rocks, is usually due to the action of plants. It is therefore thought likely that these ancient seams of graphite indicate the existence of plants, probably seaweeds.

Some of the old rocks may therefore be due to the action of living beings, of which no certain trace remains. For many years it was thought that a structure found in one of the ancient limestones of Canada was a fossil. It was named *Eozoön*, in the belief that it was "the dawn of life." But even if this limestone had been formed by some organic agency, no trace of the organism



SIR RICHARD OWEN AND THE SKELETON OF A MOA
An extinct flightless bird of New Zealand

can have been preserved; and the Eozoön is really only a banded structure due to the alteration of the limestone by an invasion of molten rock. The geologist turns from these crystalline rocks feeling that some life was probably in existence at the time of their formation, but that the secret of its origin and nature, once confided to these rocks, has been lost for ever. The evidence of the Torridon Sandstone series is still more disappointing, because some of its rocks should have preserved any fossils deposited in them. In the next rocks laid down after the Torridon Sandstone there are abundant fossils—remains of highly organised creatures, including members of so many of the chief groups of animals that they must have had long chains of ancestors. The earlier rocks, therefore, do not represent a period without life, as is implied by the name of Azoic, often given to them.

The animal kingdom is divided into two sub-

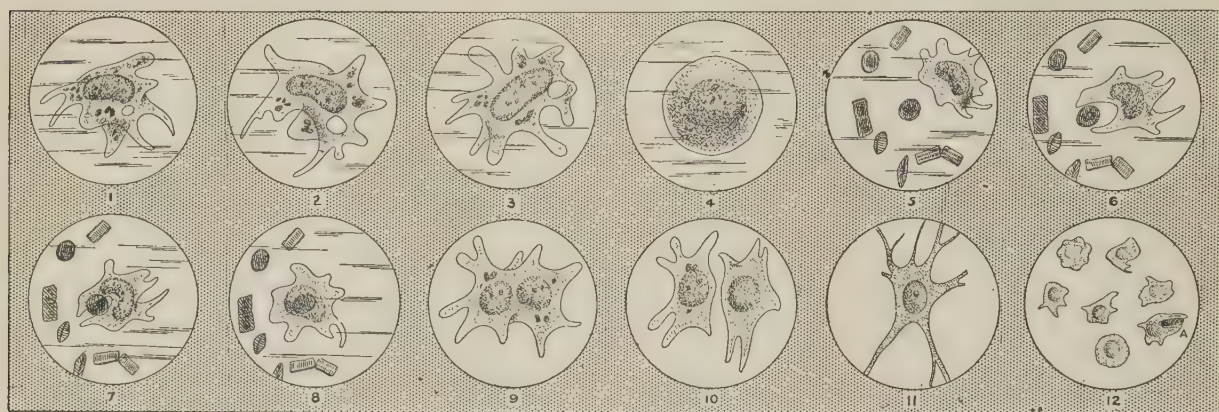
shrimps, centipedes, spiders, and insects; and the shellfish and their allies. The rest of the many-celled animals have backbones, and are therefore called the Vertebrates, including fishes, amphibians, reptiles, birds, and mammals. With the exception of the backboned animals, representatives of all these groups are known in the oldest Palæozoic rocks, and most of the groups are represented by their chief subdivisions. Fishes, however, certainly appeared soon afterwards, and thus members of all the chief divisions of the animal kingdom were living in the earlier half of the oldest group of fossil-bearing rocks; and if we follow the development of the animal kingdom, the classification based upon living animals serves for those of any previous period of the earth's history.

The climate of the earth as a whole seems to have been remarkably uniform, considering the extreme complexity of the causes that determine it. There is no indication from geological evidence



THE TRILOBITE

One of the most ancient of the crustaceans; the trilobite was indeed the king of the primordial seas



THE MINUTEST FORMS OF LIFE AS SEEN UNDER THE MICROSCOPE

1-3, an amoeba floating in a tiny drop of water and the rapid changes it undergoes; 4, its sudden change into a globular mass, when touched; 5, an amoeba approaching some diatoms, or minute single-celled plants; 6, about to swallow a diatom by; 7, folding part of itself over the food, and, 8, engulfing the plant in an improvised stomach; 9, about to divide, the nucleus separating first; 10, the division completed; 11, a nerve-cell with fibres, from the human spinal cord; 12, amoeba-like cells in human blood which devour, destroy, or otherwise remove microbes: note the various shapes these cells assume and, at A, a cell eating a microbe

kingdoms, of which the first includes animals which consist either only of one cell or of several similar cells, united together into a colony. They are mostly minute in size, and from their simple structure are called the Protozoa. All remaining animals have a body composed of many cells, which are modified into different forms, so as to serve different purposes. These many-celled animals, or Metazoa, include six groups, which have no backbone, and are therefore Invertebrate. These groups are the sponges; the jelly-fish and corals; the starfish, sea urchins, sea cucumbers, and sea lilies; the worms and their allies; the animals with jointed legs, including crabs, lobsters,

that the earth has been steadily cooling down from a more heated condition, for the climate indicated by the oldest



THE ETERNAL RECORD OF THE ROCKS

Footprints of a labyrinthodon, a huge extinct amphibian of the early world, preserved in sandstone through ages of time

sedimentary and fossiliferous rocks was not appreciably warmer than it is in the present times. There have been numerous great local variations of climate at different periods of the earth's history. One region has been colder at one time and warmer at another; but it is doubtful whether the mean climate of the whole world has been materially different from the present. At one time it was a common belief that the forests which produced the coal-seams indicated a much moister and hotter climate throughout the world

THE FIRST INHABITANTS OF THE WORLD

whole world. The view, for example, has been expressed that the sun must then have been much larger and given out much more heat, in order to maintain the vegetation that grew in the British area when the coal-seams were being formed. But at that very period vast glaciers and snowfields existed in parts of India, Australia, and South Africa, so that, at least in parts of the great continent of which those lands were then parts, the conditions were much colder than they are now.

Again, at a time geologically quite recent, the climate of the British Isles was much colder than it is to-day. All the mountains were capped by perpetual snow, and glaciers flowed down their slopes and spread over the adjacent lowlands. Greenland, on the contrary, which is now covered by a vast ice-cap, at one time enjoyed a milder climate, as is shown by the vegetation and tree-ferns that once grew there. But, as Lord Kelvin has shown, these changes in the Arctic climate can be explained by a different geographical distribution of land and water.

A considerable change in the chemical composition of the atmosphere might have had a great effect upon the animals and plants of the world, but fossils give no evidence of any change in the composition of the air. The minute structure of the plants that formed the Coal Measures shows that they lived under the same essential physical conditions as at present. The air was no doubt often moister in some localities, and drier in others, than it is in them to-day. But there does not appear to have been any sufficient change in the gases of the atmosphere seriously to have affected the structure either of animals or plants. The openings on leaves, by which plants breathed, were of the same size and proportions as are those of modern plants. The constituent of the air, other than moisture, that is most likely to have varied in amount is the gas carbonic acid; and it has been suggested that the former occurrence of glaciers in countries now too warm for them was due to a diminution in the amount of carbonic acid in the air, but no such

change has yet been demonstrated, and it appears physically improbable. It is one of the beneficent functions of the sea to preserve an atmosphere of almost constant composition. A great increase in the amount of carbonic acid in the air might have a

very decided effect upon the life of the earth, and this gas is discharged into the air in vast quantities during volcanic eruptions. The sea, however, at once absorbs the major part of the gas thus added to the air; and similarly, if the amount of carbonic acid in the atmosphere were to fall below the normal, the sea would give off some of its supply, until the deficiency had been nearly made up.

The evolution of life on the earth has also been controlled throughout geological time by constant physical limitations imposed by the strength of materials.

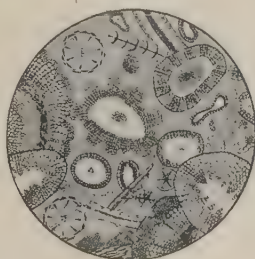
Many animals now extinct were much larger than their nearest living relations, and the discovery of great bones has often given rise to exaggerated estimates of the size of the monsters to which they belonged. These mistakes were due partly to misleading comparisons with existing animals. The thigh bone

of a kangaroo is much larger in proportion to the length of the body than that of a crocodile, which, as the largest of living four-legged reptiles, was naturally used by early naturalists as the best standard of comparison for large fossil reptilian remains. Hence, when the thigh bones of large reptiles were found, it is not surprising that the size of the animal to which they belonged was overestimated. In other cases, the size was exaggerated in consequence of mistakes in restoring broken bones.

Similarly with birds. The largest known egg is that of the *Æpyornis* of Madagascar, which is estimated as 150 times larger than the egg of the common fowl. If there had been the same difference in size between the two birds as between their eggs, the *Æpyornis* would have been colossal. The early Arab sailors knew of the *Æpyornis* egg, and, as the bird was already extinct, their lively imagination restored it as the famous roc in the tale of Sindbad the Sailor. The egg,

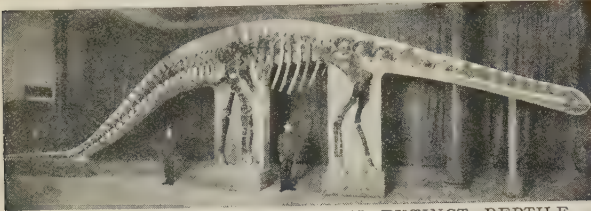


A FOREST IN THE CARBONIFEROUS AGE
The luxuriant vegetation which the ages have transformed into coal



A SECTION OF A PIECE
OF COAL

however, was laid by a bird that could not fly, like all the biggest living birds, such as the ostrich and cassowary. Indeed, it is doubtful whether any heavy or large-bodied flying animal has ever existed. Most of the known extinct flying birds were small, and as birds increased greatly in size,



SKELETON OF DIPLODOCUS, AN EXTINCT REPTILE
This monster was 80 ft. long and stood 14 ft. high

like the moa of New Zealand (see page 13), or the ostrich, or the aptornis, flight became mechanically impossible; so their wings decayed, and they were confined to running on the land.

The largest flying creatures that have ever existed were reptiles, such as the American pteranodon. It sometimes had an expanse of wing estimated at from 20 to 25 ft.; but its body was comparatively small. Dr. C. W. Andrews tells me that the length of the body was certainly not more than between 2 and 3 ft. The wings must have had a slow, heavy beat, and their main use may have been to act as a great gliding plane, with which the animal could skim through the air like a flying fox; they were less suitable for active flight than the wings of a bat. The modern albatross has an expanse of wing of 15 ft., and no larger extinct flying birds have been well established.

The limitation of the size of flying birds follows inevitably from the mechanical principle, to which Professor Barr has called attention, that the weight of an engine increases more rapidly than its power. More power can be obtained from a given weight of material by using it in many small engines than from one large engine. Hence, flying machines, which require the greatest possible power from the smallest possible weight, often use several engines instead of one large one. Nature has never produced a bird with many sets of wings, driven by independent muscles and as many distinct hearts; so the limit in the possible size of flying animals is small. There have been many land animals in the past

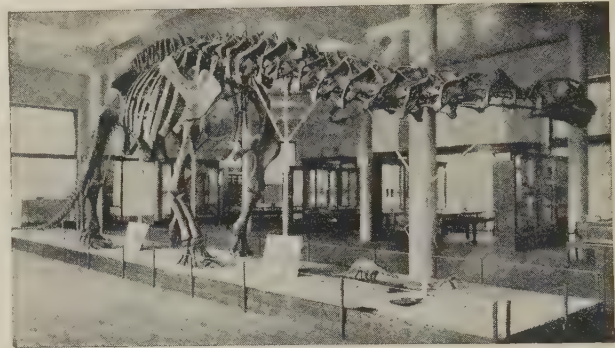


RESTORATION OF DIPLODOCUS TO SHOW ITS APPEARANCE
From the model at South Kensington Museum

larger than their existing descendants, but it is not the rule for modern animals to be smaller than their ancestors. Modern horses, dogs, cattle, camels, and giraffes are all larger than their extinct fore-runners were. It is doubtful whether any animal that lived on dry land was much heavier than the

largest existing elephant; for animals, like bridges, are limited in size by the principle that in similar structures the weight increases more rapidly than the loads those structures can bear. Professor Barr, in calling attention to this law, has pointed out that the elephant's body is almost as large as the nature of the materials allows, since an animal having a body two or three times as long, as high, and as wide as an elephant's would require legs filling up nearly the whole space under its body. Animals with a heavy body like the elephant's must have very thick legs, necessarily straight, as they are thus best adapted for supporting a heavy load. Hence, those extinct reptiles that had bodies about as large as the elephant had also thick, straight legs. Various animals have been much longer than the elephant, attaining the length of 100 ft., or more; but they lived either in water or marshes, where much of the weight of the body was supported by the soft material of the swamp or by the water.

Aquatic animals may be much larger than land animals, but no extinct animal is known as large or as heavy as the biggest modern whales, which are 85 ft. long, and weigh as much as 70 tons. Former



SKELETON OF BRONTOSAURUS
This giant reptile was over 66 ft. long, and its body was 8½ ft. thick

amphibious animals, however, were much larger than the hippopotamus, the biggest existing swamp-dweller. There is, indeed, no living land animal as huge as the giant reptiles that lived in Britain and North America at the time of the formation of the Oolitic limestones which now form the Gloucestershire hills and Portland Bill. The first known of these giants was the cetiosaurus, of which remains were found near Oxford and were referred by Sir Richard Owen to some colossal aquatic reptile.

The complete skeletons have since been found of two allied American reptiles. One of these, the diplodocus, is well known from the cast of its skeleton in the Natural History Museum at South Kensington. It is 80 ft. in length, and stood 14 ft. high, while some allied reptiles, of which only fragments are known, were even larger. The diplodocus had a very massive body; a long, tapering tail, with flattened sides, and a long neck, with a very small head. That the animal lived in water, rather than in swamps, is shown by its flattened tail, which was no doubt used for swimming. The aquatic habit of these monster reptiles is also indicated by the arrangement of their eyes. Unfortunately, the skulls



GUEREZA MONKEYS WITH THEIR SPLENDID MANTLES OF SNOWY WHITE HAIR



"NATURE RED IN TOOTH AND CLAW" PYTHON KILLING A PARROT



BATTLES OF THE WILD: GIANT HERON AND SEA EAGLE IN DEADLY COMBAT



TIGER AND TIGRESS IN THE SNOW-CLAD WASTES OF SIBERIA

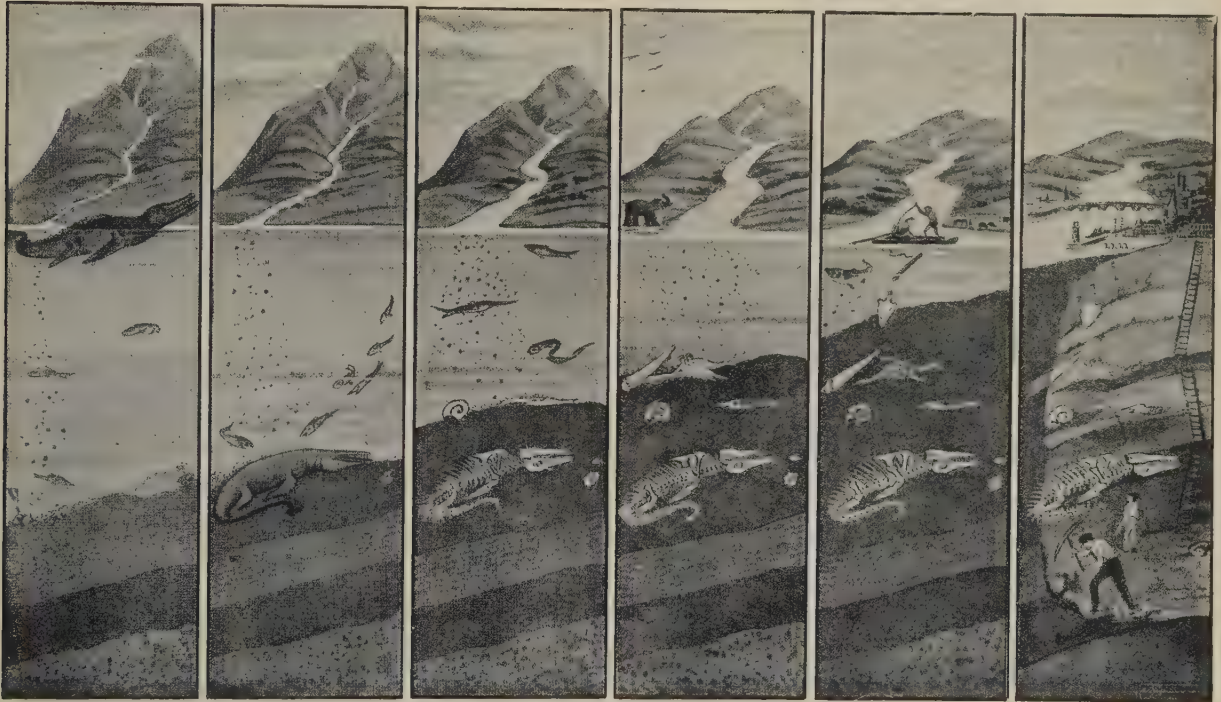
THE FIRST INHABITANTS OF THE WORLD

are usually crushed and less well preserved than the rest of the skeleton; but a skull of the *morosaurus* shows that it had a third eye on the top of its head. An eye gazing heavenwards would be of service to an animal creeping on the ground or floating on water, but of no use to a monster living on land, that towered above other contemporary animals. The *diplodocus* would have been too sluggish to dodge a falling thunderbolt, and its brain was too small to appreciate the beauty of the stars.

That these reptiles occasionally visited the land is obvious from the size of their limbs. In some, the legs may have been strongly bent, so that the animal could rest the full length of its body on the ground. On shore, the reptiles could only have moved slowly, and could not have defended themselves by the swift charge of the elephant or

the top of the back to the belly, and was raised on limbs of $8\frac{1}{2}$ to $10\frac{1}{2}$ ft. in length. The animal had a more massive and shorter neck, and a comparatively larger head, than the *diplodocus* had; its tail was shorter, and does not appear to have had the fin-like flattening. Its habits were probably also amphibious.

Land animals that belong to very different groups have often acquired similar forms owing to the influence of similar external factors. It is a great advantage to animals to stand erect. As Professor W. A. Osborne has pointed out, man is pursued by digestive troubles, owing to his alimentary canal, which was intended to be horizontal, being now placed vertically. But indigestion is, after all, a matter of detail in comparison with the advantages man has gained by his erect attitude.



HOW THE FACE OF THE EARTH WAS CHANGED AND THE EXTINCT ANIMALS WERE BURIED

This series of diagrams shows in a graphic way how the rocks have been formed by layer upon layer of fresh deposits washed down by the rivers, and how the remains of animals that had lived in the ages when the various deposits were formed became embedded therein, thus building up for us "the record of the rocks."

captured their prey with the nimble agility of lizards. They probably spent part of their time on land or in swamps, browsing, like the hippopotamus, on vegetation. If, as is probable, they laid eggs, they must have made nests on land, and stayed there for a while to protect their eggs and young.

Closely related to the *diplodocus* was the *brontosaurus*, of which the best impression can be formed from the skeleton in the Museum of Natural History in New York (see page 16). This specimen is of particular interest, as it consists of the actual fossil bones, and not of casts. The *brontosaurus* was at one time overestimated in size, and it could afford to be reduced, as its actual length was over 66 ft. Its height is less certain, as this would depend on the bending of its limbs. The body was $8\frac{1}{2}$ ft. thick from

Birds, which early adopted an erect habit, have been unable to acquire the fullest advantage from the change by the development of the fore limbs into hands, as these have been converted into wings. Several kinds of reptiles and mammals, however, have been more successful, and secured increased efficiency from their limbs by a subdivision of labour, using the two hind ones for walking and the two front ones as hands.

The fore end of land animals is often weighted by a heavy head, and the adoption of a more or less erect attitude requires a new balance that is often secured by the tail. The kangaroo is the best-known animal with this shape. Some living lizards occasionally run on their hind legs, with their front legs raised off the ground. A similar



SKELETON OF A GIANT SLOTH

form and habit were developed in various extinct mammals and reptiles. Thus, the remains of the giant sloth of South America, the *megatherium*, at first presented a puzzling problem, as they unquestionably belonged to an animal allied to the sloths which haunt trees to feed upon their foliage; but the giant sloth was so colossal that no tree could have borne its weight. This animal, however, which was from 16 ft. to 18 ft. long, presumably lived upon the ground; when it desired leaves above its reach, it stood upon its hind legs, clasped the trunk of the tree with its front limbs, and, with a mighty heave, either broke the tree across or tore it up by the roots, when it could then browse upon the leaves at its ease.

The kangaroo-like habit was also adopted by a gigantic reptile that lived in Kent and Belgium at a period somewhat earlier than the deposition of the English Chalk. This animal was first known from scattered bones and teeth found in the Weald of South-Eastern England. It was called the *iguanodon*, from the resemblance of its teeth to those of the existing lizard, the *iguana*. The true *iguana* is a comparatively small lizard, from 4 ft. to 5 ft. long. If the difference in length between the *iguanodon* and *iguana* had been as great as that between their thigh bones, then the *iguanodon* would have been 45 ft. long. The animal, however, was only about 24 ft. long, as its hind legs were much larger in proportion to the body than those of the *iguana*. The cast of a Belgian

specimen in the Natural History Museum at South Kensington illustrates how the *iguanodon* walked upon its hind legs, balancing itself by its tail and using its front limbs as paws, with which it probably collected and served into its mouth the foliage upon which it fed. That it was a vegetable-feeding animal may be seen by examination of its teeth. The head has a remarkable resemblance to that of the horse, so that no doubt the animal lived on similar food.

The *iguanodon* was one of many large reptiles that fed upon vegetation; and these herbivorous animals were preyed on by carnivorous reptiles, such as the *megalosaurus* in England and the more completely known *ceratosaurus* in Colorado. Both were probably kangaroo-like in gait; they had light, hollow bones, and were doubtless much swifter in their movements than their herbivorous relations on which they fed. They captured their prey by a rush or bound, and killed it by cutting its throat with their sharp, saw-edged teeth, as a tiger tears the throat of a cow, or their long, conical fangs punctured the skull and pierced the brain of their smaller victims.

In spite of the apparently endless variety of geographical conditions due to variations in temperature, moisture, and vegetation, the environments that are essentially different were very few. The chief were the differences between life on land, in air, or in water. Life in each of these habitats has remained under fundamentally the same conditions throughout geological time. Animals that

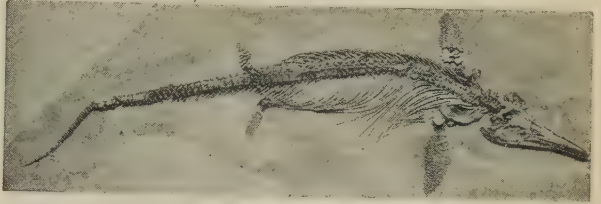


THE GIANT SLOTH AS IT LIVED ON THE EARTH

THE FIRST INHABITANTS OF THE WORLD

lived on land always had the same air to breathe ; their dimensions have been controlled by the ever-acting force of gravity, and their shapes by the same strength of the wind and radiation of heat ; and they had the same alternative of food—vegetation or other animals. Those that took to life in the air were limited by the mechanical difficulties in the flight of large bodies which have so long delayed the invention of flying machines heavier than air. Animals that live in as dense a medium as water are moulded to the shape that reduces to a minimum its resistance to their passage. The same physical properties that have shaped the modern torpedo gave a similar form to various aquatic reptiles and mammals. And as oars have been replaced in navigation by the screw propeller, so animals living in water have found the feet less efficient as organs of locomotion than the creation of currents of water by undulations of the body, or by the lashing of the tail. Hence,

them ashore, where some of them finally made their homes. The growth of animals living upon vegetation was soon followed by the development of others that preyed on the vegetarians. Owing to the superiority of land plants to water plants



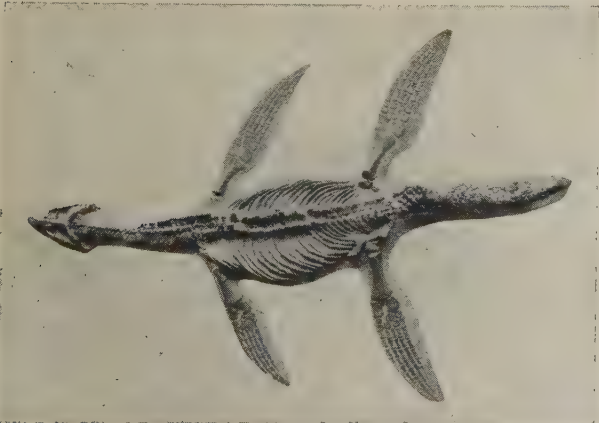
SKELETON OF THE ICHTHYOSAURUS

as food, most backboneed animals are terrestrial, though the Amphibia, the lowest group above the fishes, still, as their name implies, live largely in water. Various members of the higher groups, the reptiles and mammals, have from time



THE ICHTHYOSAURUS AND PLESIOSAURUS IN THEIR NATIVE HAUNTS, RESTORED FROM EXISTING SKELETONS

the legs soon became reduced in size. Thus, in the crocodile, they are small, and only bear the weight of the body when actually moving on land ; when stationary, the body rests on the ground.



SKELETON OF THE PLESIOSAURUS

In the struggle for existence, backboneed animals have been often forced by competition to change their mode of life. Their original ancestor no doubt lived in water ; but, as vegetation developed upon land, the new food of the fruitful fields tempted

to time returned to an aquatic life, while even some birds, such as the penguins, have lost the power of flight, and live more on sea than land.

The land animals that have returned to aquatic conditions were probably tempted by the desire for fish. The otter, with its flexible body and short legs, illustrates an early stage of the change in form produced by this change of life. Seals and sea lions have gone a stage further ; they live still less on land, and so their limbs have been reduced to mere flippers, and the propeller-like tail drives the animal forwards, like an oar worked from side to side behind a boat. Finally, in the whales and dolphins, which cannot live ashore, the hind limbs have been either entirely lost or reduced to rudimentary bones, buried in the tissues of the body. They have a fish-like form, and are popularly regarded as fishes. Their teeth, if they have any, resemble those of fishes or reptiles more than those of mammals, since all the teeth in the jaw are of the same simple conical form, such as those of a crocodile, and they have lost the difference between the front and back teeth of their terrestrial ancestors. These conical teeth are more serviceable, as they at once pierce and hold the slippery fishes upon which they live ; and as the dolphins bolt their food, without gnawing the flesh off the bones or grinding and chewing it up

into pulp, they have neither the front cutting teeth nor the back grinding teeth necessary to most land animals.

There was, among the extinct reptiles, a similar series of forms due to adaptation to the same conditions of life. No living reptile is similar in form to the sea lion, but many such existed in the period called the Age of Reptiles. The best known of these sea-lion-like reptiles was the plesiosaurus, which differed in external shape from the sea lion mainly in the great length of its long, slender neck. This animal has been compared to the head of a lizard mounted on the end of a snake that has been strung through the body of a duck which had flappers like a seal. This animal lived most of the time in the sea, and its long neck gave its head such wide and swift movement that it could catch any fish within a long reach, and its sharp, conical teeth would hold its prey as firmly as a tooth-edged vice. The form of its legs indicates that the plesiosaurus sometimes visited the shore; and the permanent adoption of life in water by other reptiles led to their acquiring bodies similar in general form, the presence of fins and the absence of legs, to the whales and dolphins. The best known of these dolphin-like reptiles is the ichthyosaurus. It was entirely

aquatic. That it dived to greater depths than the plesiosaurus is indicated by its larger eyes, which were expanded to admit as much as possible of the feeble light in the darker, deeper waters; and the eye was protected from the water-pressure by a ring of bony plates, which, when pressed inwards, formed a dome guarding the delicate structures beneath. The ichthyosaurus did not, like many land reptiles, lay eggs, for a reptile cannot lay eggs in the myriads produced by fishes, and the ichthyosaurus was ill adapted



THE EXTINCT GLYPTODON, A GIGANTIC ARMADILLO

for hatching eggs in a nest; so its young were born fully developed and active.

Though evolution has gone steadily forwards along the same main lines, the pace has not been uniform. There have been long, quiet periods, during which the rate of change was slow, and there have been intervening periods of widespread earth-movements and great geographical changes. These disturbances caused the extermination of many species,

which had acquired fixed habits and structures, and the appearance of fresh species, better adapted to the new conditions.

The main progress of evolution, however, has not

been due to change in environment so much as to the constant struggle for existence, owing to the influential fact that animals and plants tend to increase more rapidly than does the food supply. Codfish produce eggs and flowers produce pollen grains by the million, and plants produce vast quantities of seeds. It follows that only a small proportion of eggs and seeds have any chance of reproducing their kind. The unceasing stimulus of evolution has been the struggle for existence between closely allied forms of life. The progress of the animal kingdom has necessarily followed the development of plants, as all animals are dependent directly or indirectly upon vegetable materials for their food.

The struggle between animals has been strenuous, and even fierce, throughout geological history. Even in the earliest period of which we have any appreciable information as to its life, we find beds of slate in which nearly every slab contains the remains



THE PANGOLIN, SHOWING NATURE'S PROTECTIVE ARMOUR



THE ARMADILLO, A RELATION OF THE GLYPTODON

THE FIRST INHABITANTS OF THE WORLD



THE OTTER, AT HOME ON LAND OR IN THE WATER

of a trilobite (see page 14), showing that these animals swarmed in the waters in which the rocks were laid down. Some of the layers of rocks in the Old Red Sandstone are crowded with fossil fish remains; they are often so closely packed that it is difficult to separate the different individuals. They are crowded more tightly than sardines in a tin, for they are jammed together like sardines crushed into one confused mass.

These fishes had probably been caught in pools of water which gradually dried up, leaving all the dead fishes on the mud at the bottom; but they must have swarmed in the waters from which these pools were formed, and have waged a constant struggle for the available supplies of food. Ever since animals appeared upon the earth, the price of life has been the death of others. The fit have survived, and the less fit have either perished or been pushed back into positions where the conditions of life are less easy and less pleasant. Thus, sponges with a silicious skeleton were common on the shores of ancient seas, but they have been beaten in the struggle for existence, and now survive either in such sanctuaries as the deep seas or the cold shores of the Antarctic, which sponges of modern types have not yet invaded in force. Sea lilies once lived in shallow water around the British Isles, but they, too, have been driven from the coasts; they now live in the oceanic abysses with other animals too old-fashioned to adapt themselves to the fierce struggle for place and food in lighter and warmer waters along tropical and temperate shores. Similarly with land animals, the

modern representatives of many of the more ancient forms of life live in the sheltered security of remote islands. Thus a three-eyed lizard (hatteria) survives in New Zealand, and the marsupials which once lived in Europe are now extinct in the Western hemisphere except in the continent of Australia.

In the struggle between the different animals for life and food, Nature has always shown a merciless indifference to pain. The jellyfish, impressions of which are found in the earliest fossiliferous rocks, no doubt had stinging cells like their modern descendants. The primitive sharks had jagged teeth that would have given most painful wounds. The jaw of a shark is very effective from the point of view of the shark, but it was not designed to save pain to its victim. Other sharks had barbed spines that would have inflicted severe tortures on the animals they lacerated. Scorpions, found among the Silurian rocks of Scotland, probably had poisonfangs, and perhaps gave as burning a sting as those of any modern scorpion.

The first defence adopted against these instruments of torture, and against the closely set, solid,

crushing teeth, by which the jaws of some early sharks could crush fragile shells and bones like a vice, was a thick external armour. Many ancient animals were protected by a powerful calcareous or bony covering. Thus the fishes of the Old Red Sandstone lakes and rivers wore an elaborate array of closely packed bony plates or thick overlapping scales. The soft parts of ancient sea lilies were enclosed in a thick-walled chamber, which was often protected, in addition, by strong, sharp

spines. Many of the older shellfish had much thicker shells than have any of their modern representatives.



THE SEA OTTER, A RARE MARINE MAMMAL



SEA LIONS, NOW OF SO AQUATIC HABIT THEY SELDOM VISIT LAND

Land animals were also protected by a bony armour. Thus, even the primitive amphibians, the group that includes frogs and newts, were protected by plates of bone, although all their modern descendants have especially soft skins, and are usually deficient in hard defensive structures.

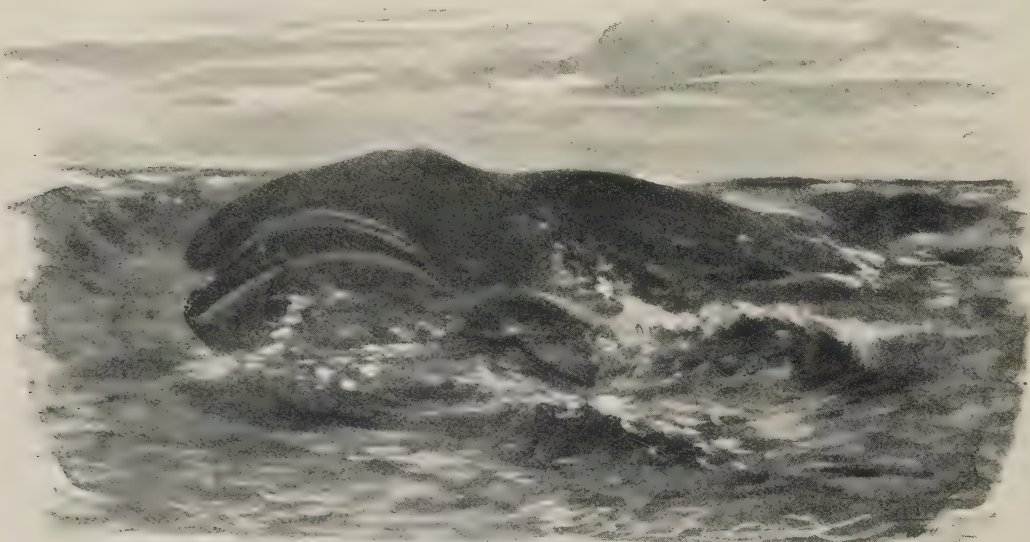
Many land animals trusted to offensive rather than defensive methods of protection. Thus, they were provided with horns, of which the most specialised forms are those of cattle and deer, whose horns are now almost as large and elaborate as at any previous period in the earth's history. There is no living deer so large as the great extinct Irish elk, of which the antlers were sometimes 11 ft. across, and weighed nearly 100 lb.; but this deer has only become extinct recently, and was possibly exterminated by man. The type of defence by horn that has been more frequently adopted is that by upright horns, borne on the top of the head, or along the middle line of the back. This type is represented by the rhinoceros, which has one or two horns upon the front of the head, but many earlier land animals, such as the tinoceras, of Wyoming, in North America, had several pairs, though they were shorter, and only one pair was probably long enough to have been of much service in attack.

Extinct reptiles show the most elaborate development of defence by a middle line of unpaired horns and spines. Thus, the stegosaurus, which once lived in Colorado, and was 25 ft. long, had a row of massive spines along its back, and some single spines were 4 ft. broad and 3 ft. high. The triceratops had rhinoceros-like horns, one on its snout and a longer and sharper pair on its forehead, and it must have used them in fighting by an upward thrust,

like the rhinoceros; and, as the triceratops had the largest known head of any land animal, the momentum of the blow would have given the horns great penetrating power.

Complete external armour is still maintained by the tortoises and turtles; but their shells are less elaborate than those of the extinct horned tortoises which once lived in Australia and South America, and had, in addition, long spikes. Armour-plating is, however, now out of date, and even among turtles many of the largest have lost their rigid armour, and have a leathery flexible skin. Among the mammals external armour is still retained by the small armadillos of South America and the scaly anteaters of India and Eastern Asia. But the existing armadillos are tiny compared with their predecessors; of which the glyptodon, for instance, had a solid rigid shell, 7 ft. in length. Armour in the strife between animals, as in human warfare, has been discarded, as it hampered rapid movement. Its weight handicapped animals that had to compete with agile foes, and it was less to be trusted than increased brain-power, which gives its possessors keener senses, quicker movement, more effective energy, and greater adaptability and resource. The bulky stegosaurus needed its weighty row of spines, but as it had a smaller brain in proportion to the size of the animal than any other known land animal, even its huge spines could not save it; and the triceratops, which holds the record for the lowest proportion of brain to skull among known reptiles, also found that safety does not depend on spikes. Animals with larger brains beat those whose trust was in armour, and those that could think swiftly inevitably replaced their more sluggish contemporaries.

J. W. GREGORY



THE WHALE, A MAMMAL THAT HAS BECOME MONARCH OF THE SEAS

THE RISE OF MAN ABOVE THE BEAST

"THE HIGHEST YET," AND THE LONG STRUGGLE UPWARD

By Sir HARRY JOHNSTON

As we survey the mammalia of the past, where do we discern the first "pointings" of man? I wish to write of this and other subjects in Natural History reverently, because to me—and no doubt to many others—the study of Life, past and present, is rapidly becoming identical with a religion—an intense, passionate desire to get a little nearer to a conception of the truth regarding the universe.

In that universe which at night we see ranged about us in the sky, and of which we know our little globe to be an inconspicuous portion, the most accessible, and perhaps to us terrestrials the most fascinating, problems are, first of all, the origin of Life, of conscious matter, and, secondly, the differentiation of mere protoplasm into more and more complex forms, and the ascent and increase of this complexity until it reaches its highest development in man—man, who, without exaggeration, seems to us to be hovering on the verge of God-like development. What is the purpose in man? What is his pedigree? Why has he been selected to be the precious isthmus, the one link between an animal past and a spiritual future?

During the last period of the Primary epoch, the Permian, in South Africa, Eastern Europe, or elsewhere in the world, there arose from the earliest reptilian forms the Theromorpha, or "beast-like" reptiles. They retained about them some features of their amphibian ancestry, but in their development beastwards they had risen from the earth on legs that were longer and sturdier; the belly no more rested on the ground or dragged itself over mud and rock, the braincase became larger, and the bones of the skeleton more elaborate and better suited to rapid movements. And the teeth, instead of remaining a uniformity of simple spikes, differentiated into three types; there were the eight—or more, or fewer—incisors in the front of the mouth for seizing; the long, sharp-pointed canine tusks—most reptilian of all existing teeth, and used for stabbing, killing, tearing; and the three- or four-coned, broadened molars for champing and grinding.

From out of these theriodont reptiles arose the protomammal, an egg-laying creature with teeth very like those of its reptilian ancestor, except that the molars began to develop double roots, but with a larger brain, a higher temperature of the blood, and an altogether peculiar form of skin-covering—hair.

Terrible was the struggle for life against the reptile monsters that dominated the land and water at that period; and the early mammals, possibly smallish animals, could only escape their enemies by activity, and cunning above all. The dinosaurs and other reptiles of the Secondary epoch grew to enormous dimensions, in this respect being really the lords of the earth on which they dwelt; but their brains had not developed co-ordinately with their

bodies. Thus they were unable to devour all their protomammalian rivals, or to avoid the bacteria, the flagellates, or the intestinal worms which caused diseases and devastating plagues, or to adapt themselves quickly enough to the changes in climate or food supply. When Nature's radiating, evolutionary plan had developed two new classes out of the reptile stock—the birds and the mammals—brain-matter, albeit in rudimentary form, had begun to count; for brain-matter would seem to be the germ of the soul and the link with the Deity.

But birds, in order to fly, lost the use of their hands; in order to bolt their fish or shellfish and the insects they began to pursue on the wing, they had neglected teeth, face, and nose, and were saddled for all time with a callous beak. The beak, it is true—like the elephant's trunk—became a very tolerable instrument, and in their later developments several groups of birds trained their hinder feet to act as hands.

Indeed, it is not altogether easy to understand why the birds missed the prize that ultimately fell to the mammals. Class for class, they have come in a very good second to the goal set up to record progress at the end of the Tertiaries. Our instincts may not be wholly at fault in associating birds with the Divine Principle, with, in fact, what we call Religion. Man from his earliest years of self-consciousness had a kindly feeling for the bird and a loathing for the reptile. If the bird has not been the chief agent in carrying out God's purpose on earth, it has at any rate received the tiny consolation prize of man's love and gratitude—gratitude for the display of the bird's ineffable beauty, exquisite song, delicious flesh, and average harmlessness.

Now, casting our eyes back to the protomammal, we realise that in its hunted existence, fleeing hither and thither before gobbling reptiles, it did not do as the bird had done—develop hands into wings and make its nest on the tree-tops, or lay its eggs on some inaccessible cliff or mountain. On the contrary, in one of those unconsciously brilliant ideas that characterise the evolutionary scheme, some protomammal and its descendants retained its eggs a longer and longer time within the body-cavity until it laid them half or wholly hatched. The living young was then gathered up, and carried or sheltered on the under side of the body between the thighs, much as the penguins of the Antarctic shelter their new-born chicks. Such an idea as the growth of the egg inside the mother's body was not new in Nature's repository, and has often occurred and re-occurred in the developmental history of invertebrates and vertebrates, especially in fishes and reptiles, living and extinct. The huge sea-dwelling ichthyosaurs produced their young in a fully developed condition, able to earn their own living, instead of laying eggs, which would need a long external development.



THE EXTINCT SABRE-TOOTHED TIGER, OR MACHÆRODUS

Gradually in the early mammals the actual laying of eggs—such as still takes place in the monotremes of Australia, the echidna and duckbill—changed into the growth of the egg inside the ovary and the birth of living young, which, still imperfect, were at first carried in the ventral pouch or fold of the skin. By degrees with the marsupials it became more beneficial to the welfare of the species to give birth to young sufficiently perfect to require no carrying about in an external pouch. We have marsupials at the present day whose young at birth are so much more grown up than those of the kangaroo—in which there has been a retrograde development—that the shelter in the inadequate pouch is little more than a formality.

In the middle or latter part of the Secondary epoch the time seemed to be at hand for the development of a mammal which could destroy other mammals, to say nothing of birds and reptiles, and be king of them all. And so out of some semi-marsupial like the thylacine of Tasmania, or an insectivorous type slightly resembling the solenodon of the West Indies, or the tenrecs of Madagascar, there appeared a beast with sharp-cusped molar teeth, long canines, and powerful fore limbs, in general aspect not unlike a hyæna or a cur dog. This was the creodont carnivore, from one of whose many differentiations sprang the porpoises and whales, from another the seals and the true carnivores of to-day. Casting aside the creodonts, Nature seized on one of their sections, improved its brain and limbs, modified the teeth, and gave the Earth a creature like a large dog, which in various aspects suggested also the civet, the raccoon, the bear, and the glutton.

Leaving the doggiest children of this dog type on one side—afterwards to produce dogs, raccoons, bears, and perhaps weasels—Nature rushed upwards along the line of rapidly improving civets, in the course of which she had thrown off the hyæna scavenger and was contemplating the beautiful but blood-thirsty cat. Then almost without a pause she started away again with an early type of cat, and fashioned it into a creature the size of a large leopard,

with very long, flat, and saw-edged tusks. And this with time and practice grew into the perfect machairodont, a creature in its South American exaggeration larger than the living lion, with immensely powerful fore limbs, huge retractile claws, and sabre-shaped teeth twelve inches in length outside the gum, a creature which may have got so extreme in its development that it no longer cared about chewing flesh, but fed mainly on gulping down the blood of bigger mammals, whose arteries it pierced with its dagger tusks.

But by this time Nature had grown sick of bloodshed, and removed her interest from the machairodont, which forthwith dwindled and vanished. She pondered over the mastodon for a time. This huge creature had not always been quite so big. Its first definite known

ancestor, the moeritherium, was perhaps the size of a large bear. The moeritherium lived in Egypt, and there, or somewhere on the eastern shores of the Mediterranean, had grown and specialised from some primitive ungulate not unlike in appearance to the hyrax. The hyrax group is well worthy of study, as although, of course, like everything else, it has its modern peculiarities and specialisation, still, of all living mammals, it represents most nearly the group which may have arisen as early as the close of the Secondary epoch, when first the great orders of mammals seem to have become distinct from the primal stock. The remotest ancestors of the hoof-bearing group, of which the hyrax is the nearest living representative, branched off from the generalised marsupial-like Eutherians, not far from the first distinct ancestors of man—the lemurs—and also not far removed from the rodents and creodont carnivora. An early peculiarity of this ungulate-lemur group was a flattening of the

HEAD OF SABRE-TOOTHED TIGER
This diagram illustrates the abnormal development of the jaws

claws into nails or hoofs. It may be that man's thumb-nails and the nails of his great toes have descended without a break from the latter part of the Secondary epoch, when this flattening of the claws began in the creatures that afterwards developed into

ungulates, on the one hand, and lemurs, on the other. Anyone who examines the hyrax at the present time, or who sees it alive in the forests of Africa running up and down the branches, more like a squirrel than a monkey, will notice that, although its serviceable toes and fingers are reduced to three on the hind feet, with the vestige of a

THE RISE OF MAN ABOVE THE BEAST

fourth, and four on the fore feet, with the rudiment of a thumb, they are much more finger-like than those of the other groups of ungulates, and in some way represent a compromise between the hands and feet of a lemur and those of an elephant or rhinoceros. Other features about the hyrax order suggest a connection in the early Tertiaries with ancestral forms of rodents and lemurs.

From out of the early types of the hyracine ungulates—which then possessed the full normal number of teeth in Eutherian mammals; that is to say, three pairs of molars and four pairs of premolars, one pair of canines, and three pairs of incisor teeth in both jaws—developed the elephant order, an early member of which was the moeritherium, which has just been referred to.

This clumsy-looking animal, the size of a tapir, had a rather long face, possibly even a snout developed like that of a tapir, six vertical incisor teeth in the upper jaw, the middle ones tusk-like in shape, four incisors only in the lower jaw, procumbent in position, a useless little canine tooth in the upper jaw only, three pairs of premolars, and three pairs of molars on each side of both jaws.

Evidently it was a creature that frequented banks of rivers, where it grubbed for roots. As it prospered, multiplied, increased, and varied, the head grew larger and longer, the incisors developed into



THE MOERITHERIUM, ANCESTOR OF THE ELEPHANT

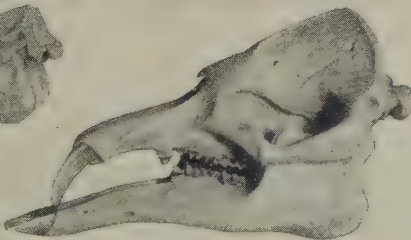
extraordinary tusks, sometimes quite procumbent, at others produced downwards, and the nostrils at the end of the long snout were extended into a short proboscis. The bulk of its body increased in size, the limbs became stouter, longer, and straighter, the toes shorter, till at last they were encased in a sort of pocket of skin, tendon, muscle, and fat, like the fingerless feet of an elephant. Then, as the long incisor teeth became more and more useful as implements for digging and grubbing, or weapons of offence, the bones of the face grew shorter and shorter. Yet in outward appearance the face was as long as, or longer, than ever, because the under jaw was prolonged in a spoon-shape and the muscles of the face remained to control the proboscis, though there was no bone to support them. This gave the ancestors of the mastodon and elephant the appearance of having an immensely long nose. But the actual nose or nostril part is not really the whole of what we call the elephant's trunk. A good deal of it is the vestige of the long face and the upper jaw without the bones.

In this manner the mastodon became for a time a candidate for the position of supremacy on earth, and, in its desire to secure the post by priority of intellect, fashioned from itself under Nature's guidance the stegodont elephants, and they, in their turn, evolved into the modern Indian and African forms. But the race is not always to the bulky. The mastodon had the defects of its qualities to answer for, and there were anatomical considerations and peculiarities which caused it to fall out of favour. It was allowed a temporary place of splendour as a curiosity with prodigious tusks—the biggest teeth that any creature has yet developed—and then withdrew into the background, though, antediluvian veteran that it is, it still, in the guise of the elephant, lags superfluous on the stage.

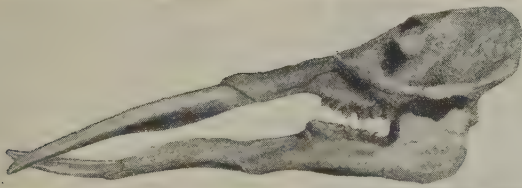
So we have eliminated all but one of Nature's candidates for Earth-mastery—the lemur. It is a moot question whether the lemurs originated in North America or in the temperate regions of the Old World. The North American lemurs—of which there is absolutely no trace among the fossils of the West Indies or South America—seem to have been of a very generalised type, so generalised in some of the examples as to have been first of all



Skull of Moeritherium



Skull of Palæomastodon



Skull of Tetrabelodon



Skull and tusks of the Mammoth

THE EVOLUTION OF THE ELEPHANT'S TUSKS

classed among primitive rodents, ungulates, and even creodonts. Even in the existing lemuroids there are traces of affinities of a very remote kind with certain groups of the insectivora and the bats, and other points which show that the first beginnings of the lemuroid development cannot have been very distant from a marsupial type. Consequently, the first "pointings" of man, undoubtedly to be found in the suborder of the lemurs, showed themselves at a time when all the Eutherian mammals might possibly have been ranged within one great order, and that not far removed from the opossums.

In North America the generalised or aberrant lemurs appear to have become extinct at the close of the Eocene, and scarcely to have lingered into the Miocene. In Europe the lemuroid development was considerable, but during the early Miocene apparently made way for the real monkeys, the surviving lemurs passing on into Tropical Africa and also into Tropical Asia, though it is just possible that the existing East Asiatic tarsier-lemur may have been received still more anciently from North America across Bering Strait.

During the Eocene Period, and perhaps the early Miocene, the large island of Madagascar was united to the continent of Africa by a broad, curved isthmus, which probably included the Comoro Islands. Madagascar may also have had an independent isthmian connection with South-East Africa and a partial or sometimes complete connection with Ceylon or Southern India by large islands across the Indian Ocean. But the main land connection of Madagascar, till it ceased to have any land connection at all, was with the continent of Africa, and when the lemurs passed down into Africa from Europe, pressed southwards by the competition of superior forms, they entered the large peninsula of Madagascar and made themselves thoroughly at home in its forests. In continental Africa—where they are represented at the present day by the wide-spread genus *Galago*, and by the West Central African *Pottos*—they were no doubt for a time without a rival amongst the mammals

frequenting the trees, and Africa at this period of its geological history—the Miocene—may have been a particularly well-forested region.

In Africa, if not in the Mediterranean region, the lemur group prospered so considerably that it was able to develop higher types with larger brains, shorter faces, and eventually a slightly reduced number of teeth; in short, monkeys of a generalised type, the fossil remains of which in Madagascar, for this transitional form evidently passed from Africa to Madagascar before the connection between the two broke up, can hardly be styled lemurs, American monkeys, or Old World monkeys. The actual fossil types discovered in Madagascar by Dr. Forsyth Major, Dr. Grandidier, and others, are still lemurs in the majority of their characteristics, though on the borders of monkeydom. But in our speculations we may well imagine that, through transitional forms of this description, the lemurs created a generalised type of monkey somewhere in Africa, north, south, east, or west, and that this generalised type was the parent form of the New World and the Old World groups—the platyrrhines, or monkeys with upward-directed nostrils, and the catarrhines, or monkeys with downward-directed nostrils. To put it briefly, Africa, we may surmise, was once inhabited by what we should call nowadays American monkeys, and this as early as the very beginning of the Miocene Period; otherwise this group could not have colonised South America.

In our survey of the ascent of man it may seem waste of time and space to go off on this side issue of the American monkeys, but it is a problem so interesting and so closely allied to the enigma of human origin that it merits some consideration.

At the present day they exist most numerous and variously in the great "peninsula of Brazil," which was once almost separated from the rest of South America by an inland sea in the basin of the Amazons, and another inland sea in the Argentine. The platyrrhine monkeys are almost as abundant, however, in the Guianas and Colombia, and they penetrate

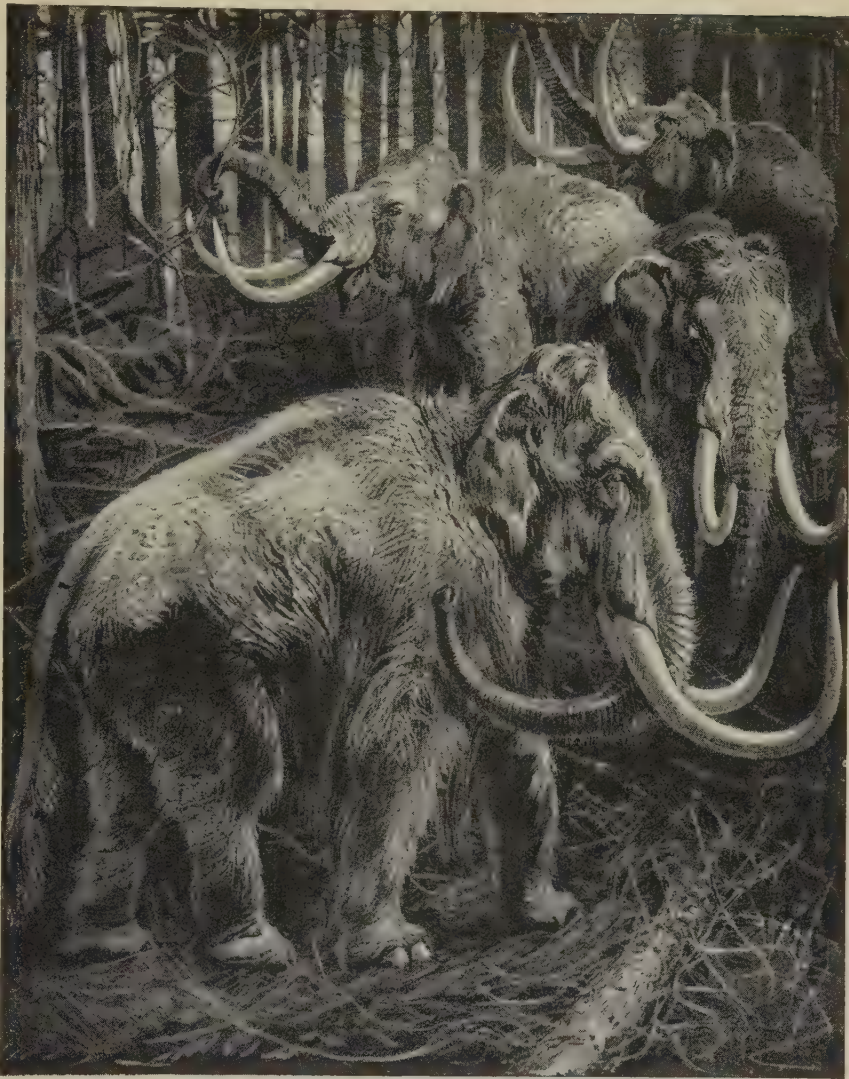


MAMMOTH APPROACHING CAVE BEARS
From the painting by F. Cormon

past the Panama isthmus—in an ever-decreasing number of genera and species—to Nicaragua and the tropical seaboard regions of Central Mexico. Their farthest range northwards towards America, therefore, is in about 20° N.; southwards of Brazil they only extend to Uruguay, and westwards to the Andes. They are found in Ecuador, but not in Western Peru, Chile, or Patagonia. Possibly they may never have reached the Pacific coast west of the Andes, but although now absent from all the southernmost part of South America, they are found fossil in Patagonia. Still, the fossil remains in Patagonia and the rest of Argentina do not represent more than one or two genera, nor do they indicate such an abundance of development as in Brazil at the present day.

So far, not a single trace has ever been found in America, or even in Mexico, of any earlier forms of American monkeys. The fossil lemurs of North America were of a more generalised, less "ape-like" type than the later lemurs of Europe or of Madagascar, and there is no evidence to show that the American monkeys of to-day could have evolved in North America, in which continent, needless to say, there is not the slightest trace among its fossils of any real monkey such as inhabited Europe from the Miocene almost to the beginning of the human period. This is the more curious inasmuch as North America was in constant communication with North-Eastern Asia by way of the Aleutian and Kurile Islands—once a continuous isthmus—and received from Asia all kinds of mammalian types which must have co-existed in continental Asia and Japan with one or more genera of monkeys. A macaque monkey inhabits Japan and Corea even at the present day, and supports a climate that has far colder winters than has Great Britain.

If, therefore, the existing South American monkeys cannot be derived from North America, whence did they come but from Africa? The only other continental region of the Old World with which South America was connected in remote times was Australia; but, apart from the fact that Australia has never had any lemurs or monkeys, it has scarcely been connected through Antarctica with South America since the middle or late



MAMMOTHS, ONCE CANDIDATES FOR THE SUPREMACY OF THE EARTH
From a drawing by Sir Harry Johnston

Eocene. The conclusion, therefore, is irresistible, and is supported by much other evidence, that Africa has been connected across the Atlantic with South America by possibly two great isthmuses, one between Cape Verde and Brazil, and the other *via* Southern Angola and St. Helena to Patagonia and the Argentine.

It is most probable, therefore, that after the sub-order of monkeys was developed from the lemurs in Africa, it sent forth large numbers of these animals from West Africa to Brazil, where they developed into their existing types. And in South America, as among the extinct lemurs of Madagascar, are remains of a man-like creature. In the Tertiary formations of Patagonia fossil platyrrhines—namely, *Homunculus* and *Anthropops*—have been discovered whose skulls, by their exaggerated brain development, offer a strong but *superficial* resemblance to that of man.

In Africa, however, as the centuries succeeded one another, and hundreds of thousands of years

were piled up, the generalised type—now specialised as American monkeys—had changed into the catarrhine or Old World monkeys as we know them to-day. And as Madagascar in this long lapse of time had become quite detached from the continent by a narrow strait of sea—not too narrow but that it might be crossed by hippopotamuses or pigs that were able to swim—it received no type of catarrhine monkey, and had to be content with the earlier transitional forms already referred to. From this generalised type of “American” monkey, therefore, there developed in Tropical and Northern Africa many of the genera with which we are acquainted.

at the end of the tail—suggest the beginning of the prehensility of the tail of the American monkeys. In the more specialised type of colobus, however, the coloration has become black with a little whitish grey, or black and white; the guerezas, the finest of all the species, have splendid mantles of snowy white hair along the flanks, and an immense white plume at the end of the tail; or the whole tail may become one huge elongated plume of white silky hair. In some points about the skulls and interior anatomy of the colobus tribe are found more resemblances to the American monkeys than in the other Old World types. They are also distinctly



THE FIGHTING DRYPTOSAURS WEIRD CREATURES OF GREAT SIZE THAT FLOURISHED IN THE SECONDARY AGES

Perhaps the most “American-like” of these are the Colobus monkeys, now only found in Africa, if, indeed, they penetrated anywhere else. The colobus monkeys are so named because they are, to all appearance, “mutilated,” in that they have seemingly lost the thumb on both hands. This loss is very recent. Apart from the fact that many of these creatures, even in the adult, show a tiny thumb-nail in the place where the thumb ought to be, the young colobus of one or two species will develop thumbs which gradually shrink and become absorbed by the rest of the hand as they grow older. Originally, these colobus monkeys appear to have been red, black, and grey, with very long tails, which in their sinuous writhings round the branches—and the more generalised species have no plumes

connected with the Semnopithecus monkeys—of which the best known is the hanuman—of ancient Europe, Southern, Central, and Eastern Asia.

The most numerous types of Old World monkey, however, are included in the sub-family of the Cercopithecines, the bulk of which are confined to Africa. It is from this group that most of the “beautiful” and pet monkeys are obtained, the mona and Diana being familiar examples.

The Baboons are now entirely African and West Arabian in their range, unless we may include among them the remarkable Black ape of Celebes. Here, indeed, is one of the most puzzling problems in the distribution and development-history of the Mammalia.

In the ancient and modern history of Asia there are no traces of any colobus, cercopithecus, or

SOME MONSTERS OF THE REPTILE AGE



TYRANNOSAURUS REX, ONE OF THE GIANTS OF THE REPTILE AGE



THE TRICERATOPS A MONSTER REPTILE WITH THREE FORMIDABLE FIGHTING HORNS

cercopithecus genus of monkey, nor has any of these types been found fossil in Europe. The semnopithecus monkeys of modern Asia, though they seem to be related to the colobus monkeys, apparently developed outside Africa, perhaps from an early colobine type, lived anciently in Europe, and nowadays are entirely restricted to the more southern, eastern, and even north-eastern parts of Asia. But they do not penetrate to the island of Celebes.

The macaques, whose range is from Gibraltar, Morocco, and Algeria, and thence, with an immense gap, through India to Malaysia as far south-eastwards as Java and Borneo, are perhaps distantly allied, on the one hand, to the mangabeys (*Cercopithecus*) of Tropical Africa and to this isolated Black ape of Celebes, on the other. The baboons, which evidently sprang from a form like the mangabey, once extended their range from Saharan Africa through Arabia—where they still exist—to India. But there is apparently no fossil or living link between the baboons of India, which may have died out as late as the human period, and the baboon-like monkey, the Black ape of Celebes.

Now, here is the problem: to trace the line of man's ascent from the cercopithecine monkeys to some generalised form of anthropoid ape, not unlike the existing gibbons.

Beyond all question we are right, on the evidence we possess, in tracing man's ascent till we get as far as the cercopithecid family. Man came from the lemur, not from any other type of early Eutherian mammal. The lemur develops into a generalised monkey, and the generalised monkeys, by the early separation of Africa from South America, specialise into two big groups, the broad-nosed and the narrow-nosed. Man could not possibly have arisen from the American monkeys for a hundred and one reasons, which need not be given here. Nevertheless, Nature—which is not particular to a premolar or two, and can very soon get rid of a tail if it stands in the way—may have hesitated for some few thousands of years from which branch she would draw the man. In Patagonia, as we have already seen, the American monkeys developed a singularly human-looking type, the little homunculus, a creature with such a large development of skull and reduced face that certain Argentine naturalists were misled into thinking that it might really be one of the direct ancestors of man. Other genera or species of American monkeys have attained considerable cranial development, and, marching along parallel lines—for the student must by no

means overlook the fact that Nature is constantly repeating herself, copying and recopying her ideas—have also assumed a deceptively human aspect.

But somewhere, some time in the early or middle Miocene, Nature dropped them in the rather callous way in which she loses interest in her failures. The germ of man, therefore, lay in the great group of cercopithecid monkeys of Africa; what route did it take to reach its final accomplishment? To me

this seems one of the most intricate puzzles in the study of the mammalia, but a puzzle not without precedent. What biologist can lay down without hesitation the similar track followed by the horse? Sometimes he is impelled to ask himself if the type of the one-toed horse, with all the other equine characteristics, did not arise in duplicate, independently, after a certain stage—one true horse appearing in North America, and penetrating to South America, and another real horse arising in Europe or Asia. If so, are both these forms to be entitled to the same generic designation of *Equus*, or are they parallel types extraordinarily like one another, but only really connected if you go back to their grandparents? Again, are they so separate that they would not breed together, and the cross prove fertile?

In like manner, was man derived through creatures more resembling the gorilla, chimpanzee, and the extinct *dryopithecus*; then a gibbon and two or three unknowns, then a form like the Black ape of

Celebes, and this again from the macaque, and the macaque from a mangabey, and so back to the cercopithecus genus? Or, behind the gibbon, did he arise from those long-tailed monkeys of the semnopithecus group, with which the gibbon has in some respects such a strong external resemblance? Some of the semnopithecines develop a nose strangely like the human nose, though less supported by bone. In such a case, though we have to get rid of a good deal of tail in the semnopithecines, we could trace man's ascent back to the colobus, and derive the colobus from the generalised group of monkeys which likewise gave birth to the American forms.

No doubt there has been a great deal of parallelism in these developments, and many of these types may have been very much in the running for the human ancestry down to the end of the Miocene Period. The baboons, for example, though lowly in some points of their anatomy, yet mentally, socially, and even anatomically, seem more allied to mankind than any other creature, except the highest forms of anthropoid ape. Of course, like everything else, at



THE HYRAX OR "CONEY"
Looking like a rodent, this small animal may be related to the elephant



THE INDRI LEMUR OF MADAGASCAR
It is possible that the lemuroids, a very ancient group, may have furnished a remote ancestor of man

THE RISE OF MAN ABOVE THE BEAST

the present day they are specialised in their own way, have re-developed a very long muzzle, have exaggerated the brightly-coloured callosities of the hinder parts and of the face. But in intelligence over and over again they suggest the beginning of man. Perhaps of all the non-human creatures they come nearest to possessing an articulate language, with their mobile lips and tongue, yet they may be only an overplus of the human idea, developed independently from the macaque-like basis.

But although the connection between the sem-nopithecus and the gibbons, which are the lowest of the anthropoid apes, may be only superficial, it seems very difficult to derive the gibbons from anything like a macaque or a primitive baboon; though it is easy to imagine such types as these two last passing,

through the Black ape of Celebes and certain extinct forms of ape, into the ancestor of man.

Were two types of humanity developed independently in later periods from two closely allied stocks of anthropoid ape? Yet were they not too far gone in difference to be able to mingle their blood, to unite after long separation, and perhaps widely different journeys through the world, and by uniting produce the genus *Homo*? Such a conjecture is not wildly impossible. Great as may be the differences, external as well as internal, between the Asiatic and African monkeys and baboons, it is remarkable to note—and this fact, of which I have often been an eye-witness in earlier days at the Zoological Gardens in Regent's Park, has never been sufficiently commented on by biologists—that a mandrill baboon from West Africa will hybridise with a rhesus macaque from India, and mangabeys and other cercopithecines will likewise unite in captivity and produce offspring. It is scarcely stating the subject too broadly to say that but for differences in size—and perhaps leaving out the colobus monkeys—it is possible to obtain hybrids from all the very different genera and species of the cercopithecoid family.

Unfortunately, the great anthropoid apes are so affected by captivity, so lose their vigour, and are so long in attaining maturity, that attempts to prove their fertility *inter se* have either never been made, or have produced no results. If such experi-

ments could be conducted by scientists—safeguarded, of course, by the various precautions to which scientific men are accustomed—and the results were that we could gaze on a hybrid between a gorilla and an orang-utan, or a chimpanzee and an orang-utan, we should be better able to conceive the possibility of two independently developed human stems—equivalent in position to the one-toed horse of America and the one-toed horse of Europe, severally derived from three-toed ancestors—having united

to form the genus *Homo*, or, further back still, *Pithecanthropus*.

The mention of this last creature, which lived in Java in the Pliocene Period, brings us finally to the consideration of the original birth-place of man. Was it in Africa, Europe, or Southern Asia? The Tertiary and Quaternary fossils of Tropical Africa

are so little known or so non-existent, owing to the geological history of that continent, that we have no means of determining at present whether Africa has ever been inhabited by anything lower in the scale of humanity than the Bushman or the Congo Pigmy. In North Africa we seem to find many traces, ancient and modern, of *Homo primigenius*, the heavy-browed man of Neanderthal, Corrèze, and Gibraltar. (The Bushman, Pigmy, and Negro belong to *Homo sapiens*). In Europe we find not only fossils of a great ape, *Dryopithecus*, but also—next to *Pithecanthropus* of Java—meet with the lowest known examples of humanity; but these emphatically belong to the genus *Homo*, and, though provisionally grouped as a separate species, *Homo primigenius*, are very near to *Homo sapiens*.

The aspect of the skull of this type of man superficially recalls the gorilla, with its huge brow-ridges, poor frontal development, prognathous face, very broad nose-opening, and feeble chin. The

teeth, however, are not more gorilla-like than are those of the black Australians at the present day; in other words, there is only a very slight approximation to the teeth of the ape, as compared with the rest of known human teeth. The black Australians, indeed, seem to be almost the direct descendants of *Homo primigenius*, and in considering what was the outward aspect of this early human race in Europe, we need not go much further than the modern Australoid. The Negro, who is practically the only



THE BALD UAKARI
A broad-nosed monkey



THE MAGOT, OR BARBARY "APE"
A narrow-nosed monkey



GUEREZA MONKEY
This species has lost the thumb of both hands

inhabitant of Africa between the Sahara Desert and Cape Colony—for the Bushman is only a variation of the Negro—preserves many anthropoid features, but was very early specialised as a human race by itself, derived, no doubt, directly from *Homo primigenius*, and probably evolved in India. Yet the negro is little more than a subspecies of *Homo sapiens*, and had as his remote parent the same ancestor that the white man and the Mongolian had.

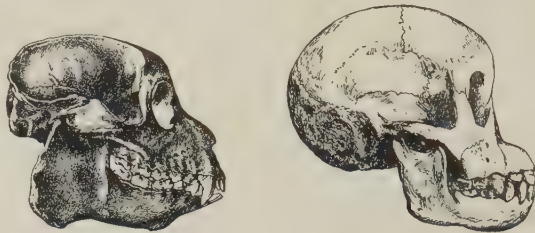
The evidence in our possession so far supports to some extent the conclusion that humanity evolved from an anthropoid ape in or near India. In Northern India are found fragments of the skull of an ape which has been named *Palæopithecus* by Mr. Lydekker. The teeth of this creature are perhaps the most human in appearance of all the teeth of anthropoid apes. *Palæopithecus* was connected, on the one hand, with the chimpanzee and, on the other, with the orang-utan, and may have migrated eastwards to Java and there have given rise to *Pithecanthropus*. The skull of the young orang is extraordinarily human, but that of the mature animal evidences much recent divergence and degradation of the genus. The same may be said of

the African gorilla. From some form like *Pithecanthropus* in the Malay Peninsula, in Further India, or in Java, may have originated the genus *Homo*.

This at first existed in a generalised type, named by some authorities *Homo primigenius*. India, which seems to be the matrix of fully half the Old World mammals, and which was quite possibly the scene of man's first emergence from the simian family, appears also to have witnessed the variation of *Homo primigenius* into *Homo sapiens*, and *Homo sapiens* into its modern subspecies; to have been,

namely, the region in which the negro, the Proto-Caucasian—almost the equivalent of the black Australian—and the Mongol races arose divergently from the first truly human type, and migrated westwards, eastwards, north-westwards, and north-eastwards to conquer the world from the imperfect, because untutored, grasp of *Homo primigenius*.

Both *Homo primigenius* and *Homo sapiens* were of the family of man, because they had a brain-space in the skull of over 900 cubic centimetres, walked erect with the big toe more or less level with the other toes, had small canine teeth, no space or interval between any of the mature



SKULLS OF MESOPROPITHECUS PITHECODES AND OF A YOUNG ORANG



SKULL OF THE APE-MAN OF JAVA



CONJECTURAL RESTORATION OF THE CAVE MAN WHOSE SKULL WAS FOUND IN CORRÈZE, FRANCE

THE RISE OF MAN ABOVE THE BEAST



HOMO PRIMIGENIUS, THE MAN OF NEANDERTHAL AND OF PLEISTOCENE EUROPE

Drawn by Sir Harry Johnston to illustrate the probable appearance of the earliest type of man in Europe

teeth, a nose—not merely fleshy nostrils—a large development of the gluteal muscles, producing fleshy buttocks, a spinal column with a pronounced inward curvature, and specially human features in the liver, brain, the leg muscles, and sexual organs. They were also in all probability but scantily covered with hair on the body, though far more hairy than their modern descendants. Both sexes in early man had whiskers and a thin moustache and chin-beard, and the head-hair was long and abundant, to atone for the disappearance of the hair on the back aspect of the body from neck to heels.

Even Pithecanthropus, we may

suppose, used the implements provided by Nature—stones to throw, shells to cut, sticks to fling, strike, prod, or thrash. But Homo sapiens soon improved on these natural implements, and turned the unaltered materials around him into serviceable articles; deliberately shaped the weapons and tools with which he emerged from his struggle for feeding-grounds and shelters first with his primigenic brother, and next with the beasts of the forest and field.

Thus the clumsy primigenic man was originally driven from his Asiatic home by the swarming and successful Homo sapiens, and blundered into



A TIERRA DEL FUEGO FAMILY OF THE PRESENT DAY, SHOWING HOW PALÆOLITHIC MAN LIVED

Australasia, into Europe and North Africa, perhaps also North-Eastern Asia, repelled, however, from too northern a trend in his wanderings by the waxing cold of the Pleistocene Period.

But *Homo sapiens* was stopped by nothing, not even by those glacial periods which sealed and fortified his manhood by compelling him to think, to master many elementary arts and industries, to make fire, to strip off the skins of fur-bearing animals for his own covering, and to build shelters against the inclement weather or the too aggressively attentive wild beast.

What were the special foes of early man among the lower creation? As soon as he took to a ground life, and ceased altogether to be an ape, he had good cause to dread the attacks of intestinal worms like the hook-worm, which deliberately enters through the pores of the skin and fastens on to the viscera; or the filarial worms which may be absorbed in drinking-water; or leeches and ticks coming from the grass; or the still more terrible bacteria and protozoa introduced through the punctures of fleas, mosquitoes, flies and other insects. Many of these worms and insects were attracted by the exuviae which accumulated round the primitive human settlements, for early man was very dirty and insanitary in his habits, if we may judge him by the lowest peoples of to-day. No doubt the bare skin of humanity was partly produced by an innate desire of the terrestrial ape that there should be as little harbourage as possible for these invertebrate pests which threatened him with diseases and anæmia and even extermination.

His vital energy being great, he accustomed

himself to many of these intrusive micro-organisms, and his restless migratory habit further saved him. As to his visible enemies—putting aside lightning, floods, landslips, volcanoes, and blizzards—they were not many so long as he kept himself to himself. In his original Asiatic home he had the dangerous leopard to contend with, and perhaps the incoming tiger and lion from the north-east and north-west. Snakes occasionally bit or strangled him if he got in their way, crocodiles lay in wait for him by the riverside, and a solitary wild boar, wild bull, or buffalo, elephant, rhinoceros, or stag, may have pursued him out of wanton rage.

When man emerged into temperate Europe, Asia, and Africa, he found the grizzly and the cave bears, the cave lion, cave hyæna, and troops of wolves ready to attack and devour him unprovoked; but against these enemies his social life of the clan or tribe, his use of weapons and of fire finally prevailed. When he himself became a fierce carnivorous hunter of other mammals he had to suffer occasionally in a losing battle with an infuriated bison or auroch, mammoth or megaceros, but the contest was one which he had deliberately sought, and which he could almost always avoid. These were among the dangers and drawbacks of his lot and he was prepared to face them. He had achieved his indisputable superiority over of creation from the day on which he conceived the use of weapons outside his own person, and the principle of acting in concert with his fellow-men.

H. H. JOHNSTON.



A NEGRO

The typical native of Africa from the Sahara to the Cape



A TITANIC CONFLICT BETWEEN PRIMITIVE MEN AND A TRAPPED MAMMOTH

From the painting by V. M. Vasnetzoff in the Historical Museum at Moscow

THE TAMING OF THE WILD

HOW MAN GAINED DOMINION OVER THE ANIMAL WORLD

By Sir HARRY JOHNSTON

UNTIL the human genus was fully established, with an average cranial capacity of 1,000 cubic centimetres, almost, indeed, until the human type had, in Southern Asia or Central Europe, developed into the existing species, *Homo sapiens*, there was little room in the mind of man for altruistic conceptions in regard to other animals. For the most part he regarded his fellow mammals as things to be hunted and eaten, or creatures which might hunt and eat him. From the anthropoid ape stage in his career to that of full humanity he had passed through a severe struggle to survive the attacks of leopards, tigers, lions, jaguars, enormous pythons, the great crocodile of the marshes, the vipers and cobras of the brushwood, and the petulance of bad-tempered bull-elephants or buffaloes. Here and there, no doubt, he had fierce combats with his long-armed, long-toothed gorilla cousins before they yielded and fled before him into the recesses of the African forest.

But when man's position was secured, his self-consciousness established, and his soul born, he looked on the world outside him in a different aspect. Tacitly he acquiesced in the existence of wild dogs, hyænas, jackals, vultures, and such-like creatures, hanging round the outskirts of his caverns in the hills or his forest patch in the middle of a savannah or a marsh. They fed on the offal round his home, the uneatable fragments of his repasts—skins, bones, legs, and viscera—and they in their turn, as they do even in the present day, warned him of the approach of their common foes—python and leopard, rogue elephant and child-slaying eagle.

Out of fear, and from some unconscious adherence to an unspoken pact, they left his children pretty much unharmed, unless a child wandered too far from the centre of the clan. There is a sense of tabu, or "things forbidden," even amongst beasts, birds, and reptiles. The cobra that is daily fed with a saucer of milk would have to be much and wantonly provoked before it flashed its fangs into the baby of its host; crocodiles—as I can testify from the evidence of my own eyes—leave unharmed the plovers that pick the leeches from their open jaws, and also the great water birds that frequent the sandbanks; these on their part warn by cry or flapping of wings the sleeping crocodile when its only enemy, man, approaches.

When the human herd shifted its dwellings and went to seek fresh hunting-grounds, it would be followed at a more or less respectful distance by its attendant troops of wild dogs, jackals, hyænas, and vultures. Thus I have seen myself, in the early days of East Africa, the Masai warriors followed from encampment to encampment by the same creatures, with the exception of the wild dog.

At last a more definite community of feeling would spring up between some of these animals and man. Vast herds of buffaloes, which then covered

so much of man's first home in the tropics of the Old World, would soon grow accustomed to, and even benevolent towards, these troops of perfected apes. Man in those days would have hesitated to attack a buffalo or to excite the anger of a bull or cow by the abstraction of a calf. On the other hand, both had cause to dread the great predatory cats. The shouting, shrieking, and banging of tree-trunks, with which the quasi-humans announced the presence of a leopard or a sabre-toothed tiger, would give the buffaloes the necessary warning in time to be on their guard and gather their calves within the mass of the herd.

But unquestionably the dog was the first to be man's friend, ally, companion, and subject. The affinity between this generalised carnivore—which has been able to remain generalised in all but the development of its brain—with its conception of association and tribal combination, began, no doubt, far back in apehood. There is a singular mental affinity and affection latent in almost all monkeys for dogs, and in almost all dogs for monkeys. The fiercest captured baboon, longing to bite and tear any human being within reach, will suddenly soften at the sight of a terrier; and the most truculent bull-terrier will develop unexpected friendliness towards a ridiculous gambolling monkey. Of all the pets that can be given to anthropoid apes to console them in captivity, if consolation they require, there is none to which they take more readily than to a dog. This attraction of the one type to the other may even be traced as low down as the lemurs.

But this affinity of feeling between primate and canine scarcely goes beyond the dog. It may be that the dog subgenus alone has reached a degree of mental development which, as in the case of the parrot, the anthropoid ape, and the cat, raises attraction above the instinct of kind associating with kind to that of soul associating with kindred soul.

Among savages of the present day in those regions where dogs and even wolves abound, it has been not an uncommon incident for a mother who is grieving over the loss of her child to bring up a wolf cub or a puppy instead; still more strange, it is averred not only by legend, but by modern observations, that wolves—and therefore possibly wild dogs—will suckle motherless children instead of their lost puppies. Anyone who has studied the wild or the savage people in Africa, Asia, and America has noted the affection evidenced by the pariah and tribal dogs for the children of the clan. In some parts of Africa a child and a puppy are brought up together, and become lifelong friends. Few things in Nature, in fact, from our present outlook on the world, appear to us more beautiful than the devotion of the dog to man. It is so complete that the dog entirely surrenders himself to the will of a creature who is removed from him in relationship and



DOGS HELPING EARLY MAN TO HUNT THE BOAR

development by three or four million years, though the development along some lines has been parallel. At the behest of the man, woman, or child, to whom the dog has attached itself, everything is to be attacked—the rest of the dog-world and all alien humanity not excepted. Yet the dog will not hesitate to recognise as his companions and sedulously respect all such other humans, beasts, birds, and reptiles as are placed under his owner's protection.

It was, however, mainly attachment to the principle of co-operation on both sides that so specially drew the dog and man together as allies in the dawn of humanity. In those days man was often pitiless towards wife and child. But for his dawning consciousness of the value of tribal organisation he would have slain the comrade and snatched the comrade's widow. Without any remorse he would let his mother die of hunger when she was no longer a useful adjunct of the community; and when the father became a nuisance in his tyranny, brothers might band together to slay their parent and peaceably feast on his remains, sleeping afterwards without remorse until dreams, provoked by indigestion, initiated the terrors of religious belief. If the dog had gone solitary, like the fox, man would have overlooked him, or have killed him for his coat, or even have devoured him, when the frightful pressure of the struggle for existence turned him into a blood-thirsty carnivore. But if he attacked a troop of dogs, they all stood by one another. On the other hand, the dogs feared to attack a lonely woman or

child, in the dread that their cries would attract a large concourse of men with bludgeons and missiles. For the early dog dreaded the throwing powers of humanity far more than the impact of a club or a sharp flint derived from a hand-to-hand struggle. It was the capacity of this creature to *throw* which made such an impression on the mind of the dog. You might avoid contact with the powerful hands or fists of early man, and his teeth had already become a negligible quantity; but if you merely stood at a respectful distance and bayed, you could still be struck and perhaps killed by the heavy stones or crooked sticks flung at you by his long, strong arm with ever-increasing accuracy of aim.

So the man and the dog made an unwritten and unspoken bargain. When the dogs saw that the humans were sallying out to hunt, they followed, and before long they ran alongside. Man wounded the game, and the dogs ran it down. Man kicked the dogs aside and took the best of the slain beast, but he always left behind enough to satisfy the hungry pack; and even if he did not, then and there, he raised no objection to the removal of the offal from his camp by the dogs which frequented it. Consequently, the more man prospered, the happier became dog life, until the camaraderie not only resulted in the development of two or three hundred different breeds from the original, a creature very like a dingo, but also established what is undoubtedly a great and precious principle—that man in his mastery of the earth need not necessarily exterminate every other living creature which he cannot use for food or clothing, as a beast of burden or traction, or as a creature to provide ornaments or manure.



THE SHEPHERD'S DOG AT HIS MASTER'S GRAVE

From the painting by Sir Edwin Landseer, R.A.

THE DOG AS MAN'S HELPER IN THE CHASE

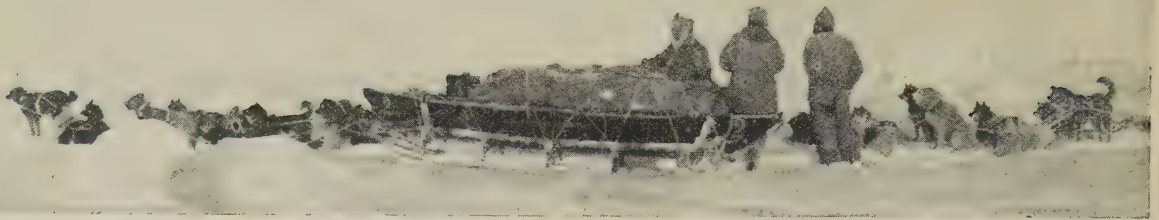


THE BEAR HUNTED BY DOGS



THE WILD BOAR HUNTED BY DOGS

From the paintings by Frans Snyders in the Dresden Art Gallery



CANINE HELPERS IN POLAR EXPLORATION: ESKIMO DOGS DRAWING SLEDGES IN THE ARCTIC REGION

One likes to think that the dog—not always necessary now that we have developed electricity as a house guard—is, nevertheless, still being kept and maintained because of its community of mind with man; because of its beauty, its half a million years of faithfulness; its participation in man's struggles, defeats, joys, and triumphs. Has it not had the honour at the North Pole and the South Pole—associated in the last region with another of man's ancient allies, the horse—to assist in enabling mankind to view the last undiscovered portions of his present home? Indeed, about these recent Polar discoveries there are two very significant facts which should tend to the softening of racial and of animal prejudices. A black man as well as a white man, according to the white man's story, stood alone on the patch of ground in the Farthest North, where the earth is neither north, east, south, nor west, but where the central point of its axis faces alternately perpetual day or perpetual night. And neither of these men could have got there with the present means at man's command but for the vigour, endurance, and obedience of Eskimo dogs. Likewise, when Sir Ernest Shackleton got within a hundred miles or so of the Antarctic Pole, he did so not only with the help of equally faithful dogs drawn from the Far North, but by using the muscles and feeding on the flesh of ponies—ponies, perhaps, not widely different in appearance from the first horse tamed by man.

An immense interval in time, no doubt, separates man and the dog from man and the domesticated ox, sheep, goat, horse, ass, pig, buffalo, goose, llama, cat, camel, silkworm, reindeer, duck, peacock, hawk, goldfish, turkey, guinea-pig, rabbit, ferret, guinea-fowl, pheasant, swan, quail, and canary—a list which represents the principal beasts and birds that have been more or less permanently domesticated by the patience of man, and gives, as nearly as possible, the imagined order of their domestication.

Force of circumstances made man, as soon as he *was* man, a great hunter and fisherman. Troops of humans wandered along the sea-coasts of Tropical Asia, gathering, opening, and eating shellfish. With their hands, and later with implements, they fished in rivers and shallow sea pools. They built dams of sticks and trunks across the bed of a rivulet, and caught the fishes thus arrested on their way down stream. They first of all killed large animals, which fell into natural pitfalls or stuck in marsh mud. Another leap of the intelligence invented the trap and the springe. The elastic rind of palm fronds, and later the fibres of innumerable plants, gave the strings which were used in these traps, and were afterwards applied to a pliant stick, which became the bow. In fact, the pitfall led to the trap, and the trap led to the bow and arrow.

But at last increasing numbers, competition, hunger, and other causes drove man northwards from that part of Tropical Asia in which he had been born—Malaysia or India. Southwards and eastwards were great islands. Some of these he and his successors reached by floating logs or some temporary uprising of the sea-bed, so that a straggling of a low type of humanity penetrated to Australia and Tasmania. But the main progress of man from his Asiatic centre was northwards and westwards. With his powers of intellect and of artifice he soon overran the whole habitable world, but always and everywhere as a hunter, as a carnivore, with one domestic animal, the dog.

Century followed century, millennium millennium, and still found man hunting, feasting on flesh, fish, and shellfish, with such roots, mushrooms, fruits, nuts, leaves, and wild grain as he could obtain directly from Nature's hand. His life as a hunter of big beasts led him to follow the wild horses for their succulent flesh, and, above all, the bison and cattle. Every now and again he would kill some cow with a



AN ELK SLEIGH IN ARCHANGEL



TEAM OF REINDEER IN NEWFOUNDLAND

defenceless calf, and would drink not only the blood of the slain cow, but would press the milk from the full udder, and drink that likewise, and the calf would be driven home to the kraal with some vague intention of preserving it for future consumption when it was older. As there is pity in an ape or a monkey, so still more there should have been pity in the mind of primitive woman; and one such, two such, twenty such no doubt took compassion on the half-grown calf, and signified that it should not be killed.

With the uprise of Neolithic Man came, no doubt, the great development of taming and domesticating beasts and birds, and agriculture—which, in point of fact, is the domesticating of vegetable forms.

Around the cave entrances or the rude huts of a Palæolithic settlement the seeds of certain edible plants grew more luxuriantly in the manure and offal of the human settlement than outside among weeds and stones. This attracted the attention of the more intelligent type of man which was rising up in Asia or Europe; and seeds of such plants were deliberately planted in favourable spots where they might grow luxuriantly. In this way agriculture began, but before man tilled the ground he was a herdsman, just as he was a hunter first of all. And

North, were regarded with a new-found awe, due not only to admiration of palpable strength and bulk or sheer beauty, but to a consciousness of motives, symbolism, intangible forces, embodied or typified by some of these creatures. This bird heralded the coming of spring, with vivifying rains and warmer sunshine. This beast, if let alone, multiplied at the time of harvest, and became accidentally associated with productive crops; that reptile dwelt in the places where their dead were buried, and so might be a warden of the spirit world.

So that a good deal of the domestication of beasts and birds, and licence allowed to reptiles, arose not only from a matter-of-fact belief in their value as food or means of transport, but in feelings of superstition and religion. It is doubtful, for example, whether the cat, first domesticated in Egypt from a wild African species, was tamed so that it might catch mice and rats, or because it seemed the dwelling-place of a goddess, and for that reason ought to be protected and induced to dwell in the habitations of the people by whom it was worshipped.

But the ox (*Bos taurus*), though afterwards worshipped as perhaps no other beast has been in Europe, Asia, and Africa, was certainly first drawn



CARAVAN OF CAMELS CROSSING A DESERT IN THE NORTH-WESTERN PROVINCES OF INDIA

the first herdsmen arose not in America—which is rather a side issue and an overflow of humanity than a chapter on the main line of man's ascent—and perhaps not in Europe, but in Western Asia and nearly simultaneously in Northern Africa.

These Neolithic people had, with increased security, food supply, and leisure to think, greatly advanced in their ideas of religion. In a sense, a wider humanity opened to them. More distinctly and more firmly than did Palæolithic Man, they attributed souls, and even dominant souls, to the beasts and birds, the reptiles and the insects around them, and to the great forces of Nature in river and sky, harvest and fire, disease and its remedies, the begetting of life, and the process of death. Not only did they fear the lion and the bear, but they deified these brother beasts. The hippopotamus typified a goddess, the elephant a god, the cat was protected, and made tabu in virtue of its "slimness," its beauty, its large saucer eyes. Even that persevering scarabæus beetle rolling up the ball of dung and dust which contains its eggs was looked upon as the embodiment of a great principle, and no longer was crushed under the heel of the sandal. The ibis, vulture, eagle, hawk, fish, and wolf, the leopard, and no doubt the mammoth and hairy rhinoceros, lingering in the

into the fold of man for a utilitarian purpose. Cattle were domesticated to create a reserve supply of meat against hard times; then came the idea of using the superfluous milk that was more than sufficient for the rearing of the calf; and in some directions the milk and dung of the cattle assumed such importance in the eyes of the people that the flesh was tabued as sacred. The bison, on the other hand, for some reason we do not understand, never lent itself to domestication, though it abounded in enormous herds in Spain, France, Germany—on the verge of which it still exists—and Russia, in the time of man of the New Stone Age.

After a first attempt at taming ibex and audad, we find that domesticated sheep and goats of ancient Egypt were derived from the same Eurasian species as those which have supplied Europe, Asia, Negro Africa, and the whole world with their present stocks of sheep and goats. Sheep of the earlier Neolithic type in prehistoric Europe and Asia seem to be little else than a tamed moufflon, in many respects like the wild moufflon of Sardinia and Corsica, which once had a far greater range in various subspecies over Central and North-Western Europe, even reaching to Britain, in perhaps three different subspecies—possibly early domesticated

forms brought by the first Neolithic tribes. Mr. J. G. Millais thinks that one of these still survives in the remarkable little Soa, or Soay, sheep of an islet in the St. Kilda group, west of the Hebrides.

Curiously enough, the Hottentots who crossed the southern part of Africa from east to west two thousand or fifteen hundred years ago, coming apparently from what is now German East Africa, brought with them the Egyptian type of ox and the North-east African fat-tailed sheep, but possessed no goat; though there are many reasons for supposing that the goat permeated Negro Africa before the sheep, which last is still rather a new animal in parts of the Congo basin.

The horse loomed very considerably in the scope of vision of early man in the Old World. The equine species indigenous to North America may have become extinct soon after the arrival of the first human beings in that continent—more likely from the ravages of a tsetse fly, found fossil in recent American deposits, than from the attacks of man; and man certainly co-existed with a clumsy, red-haired, white-spotted equine in South America, the Hippidium by name.

We have no reason to suppose that any lingering horse species or genus was of particular importance to man in America before the coming of the European. But in Europe, and possibly Central Asia, Palæolithic Man thought much of the horse as an article of food, no doubt rounded up the herds by a concentrated tribal attack, and drove them into blocked-up gullies, or other arranged traps, much as the wild negroes of Africa do, or used to do, with zebras and other game. Then the usual procedure would follow; foals would be caught, which were not immediately required for eating. Boys of the clan would make pets of them, perhaps climb on to their backs, and gradually the idea of the horse for transport or riding might occur to the mind perhaps of the first Neolithic men in Europe. But the real domestication of the horse seems, like that of most other beasts and birds, to have taken place in the as yet unlocated original home of Neolithic civilisation, somewhere in south-easternmost Europe or Western Asia.

The true horses of, let us say, 7000 B.C.—as apart from the asses and zebras—were natives of all Eurasia south of the ice cap, and of much of

sub-Tropical Asia. There may have been a wild horse in North Africa as well, but this is not certain. For the most part, the horses of Europe and of temperate Asia were of a type resembling either an underbred cart-horse of the present day, or the very similar existing wild horse of Tibet. But in Asia Minor, Syria, Persia, North-Western India, and Northern Arabia—it may be also right across North Africa to Mauretania—there seems to have been a subspecies differing from its northern congener in the possession of a more elegant shape, a smaller head, a smoother, sleeker coat, and, most important feature of all, a tail set on with a fine arch and heavily plumed from its very base; whereas the tail of the northern horse is what one sees in the Przewalski wild horse, set closer to the body at its root, and not beginning its expanding plume of hair until some inches away from the base.

This southern horse was no doubt the origin of the Barb and Arabian breeds. It was the horse ridden by the Asia Minor Hittites, and either inhabited Cyprus from the time of that island's connection with the mainland, or was early imported thither as a domestic animal. The Cyprus horses represented in the ancient art of that region are obviously of the Arabian type. In Northern India, the southern and the northern breeds may have mingled in domesticity, and the result of that cross-breed has found its way in various pony shapes to different countries, such as Burma, China, Japan,



BREAKING BISON INTO HARNESS

and right down south as far as the island of Timor.

The horse was relatively late in its arrival as a domesticated animal in Egypt, but was soon employed extensively by the Egyptian kings for their chariots in war. In the domesticated state the horse has had a career of quite seven thousand years in Europe, if not longer. In the cave drawings of France, which may be fifteen thousand years old, the horse is occasionally shown as though covered with a dressed skin as a saddle, and with indications of reins or head-stall. The horse of the Greeks was mainly of northern origin, with its hog mane—the long, drooping mane is a feature of the southern horse—its large head, and stout legs. But in Asia Minor the northern and southern breeds mingled, as may also have been the case with Northern Africa and Southern Spain. In Britain, a generalised type of domesticated horse was probably created from

MAN'S BURDEN BEARERS IN EASTERN LANDS



CAMELS, ELEPHANTS, AND OXEN EMPLOYED AS BEASTS OF BURDEN IN INDIA

The top picture on the left shows the camel as a substitute for a watering cart in Bikanir, and that on its right the Rajah of Nabha's elephant employed in watering. The centre picture shows a camel omnibus conveying luggage, and in the lower one elephants and oxen are drawing waggons.

the wild stock by Iberians and Celts long before the arrival of the Romans, and the main progenitor of British domesticated breeds down to the opening of the sixteenth century was evidently the indigenous British wild horse, scarcely differing from the northern type of Europe and Asia, though quite conceivably it may have been smaller in size.

The Egyptians first domesticated the African ass; and almost simultaneously the Asiatic ass, or onager, was tamed by the people of Mesopotamia, but does not appear to have been so successful a domesticated animal as was the African. Still, there has evidently been an interbreeding between the Egyptian and the Persian or Syrian wild asses in captivity, and this mingling has produced the handsome, large-sized riding donkeys of Eastern Arabia and Southern Persia, which have played a considerable part in the civilisation of Moslem East Africa and of Egypt,

into those regions, whence it passed on to Malaysia. Here, mixed with a domesticated local species, it became the most important homestead animal of the Malay Archipelago and the many Pacific islands, being carried nearly everywhere by the restless half-Caucasian Polynesian race, as far away from the Malay Peninsula and Sumatra as Hawaii and Samoa, but never to lonely, sulky, savage, Palæolithic Australia, wherein—and in Tasmania likewise—man never knew any other domesticated animal but the sheep-farmer's plague, the dingo; though Melanesia and New Guinea possessed the pig and perhaps the fowl.

The wild boar of Europe is the original parent, together with a later admixture of the Asiatic race from China, of all modern domesticated breeds. It was, no doubt, first tamed by that remarkable nucleus of Neolithic Man somewhere in Western



A TEAM OF WHITE BULLOCKS DRAWING AN INDIAN RAJAH'S GUN-CARRIAGE

and even, perhaps, of Europe of the Middle Ages; for they attracted the attention of the Crusaders, and were imported by them into Europe.

Mules seem to have first come into existence about 1500 B.C. in Asia Minor. They proved at once of great use for transport, especially in the mountains, but did not attain great popularity as riding animals until the beginning of the Mohammedan era. The Crusades made them much more widely known and used in Europe, though the Arabs had firmly implanted mule-breeding among the industries of Spain. In France, mule-breeding did not begin till the beginning of the eighteenth century.

The pig was probably domesticated in several parts of the world independently, perhaps first of all by the early Aryan invaders in Northern India, in which case the wild parent would be the Asiatic wild boar. Similarly, the prehistoric Caucasian invaders of Indo-China carried the tame pig

Asia or Eastern Europe from which all civilisation seems to have radiated. But the process was probably repeated over and over again from Ireland to Japan, and North Africa to Lithuania, wherever a pig of the *Sus* genus could be caught young and brought up as a plaything and village scavenger. Even in Palæolithic, savage Africa, the superior negro types in the Western and Central Sudan, dwelling on the northern limit of the great forests, tamed the indigenous red river-hog. It is interesting to note that almost the only creature the negro has ever attempted to domesticate from out of the wild animals of his own land is the red river-hog of Equatorial West Africa. On the verge of the Egyptian Sudan, in the forests of Liberia, and here and there in the Congo basin, the natives capture the young of this pig and bring them up by hand, so that they run about the village tame, or are even kept in styes for food. There is no reason



TAMED ELEPHANTS DRAGGING HOME WILD ELEPHANTS CAPTURED IN THE INDIAN JUNGLE

whatever why this very handsome animal should not be added to our list of domesticated beasts, except the desire of the European sportsman to slay, and slay, and slay without stopping to think.

In the British Islands, the wild boar is thought to have existed in a smaller, longer-legged form than on the Continent, and has been provisionally named, in scientific language, *Sus scrofa britannicus*. There may have been another local subspecies in Ireland, the ancestor of the now nearly-extinct greyhound pig of domestication. The domesticated swine of Britain of the Roman period and Middle Ages were very like miniature wild boars, and only became shorter-headed in the seventeenth century, when from the Continent there began to be imported the "Polish" breeds. These had reached Eastern and Central Europe from China, in the train of the Tatar conquerors before they became Mohammedans. The Chinese were the first to pay attention to pig-breeding and to develop a plump, short-headed breed.

By whom was the Indian elephant first tamed? The impulse possibly arose among the Aryans, who first crossed the Himalaya and invaded India and Further India from ten thousand years ago onwards. And "Aryan," as we grope our way back into the past, only seems to be another and interchangeable name for the first Neolithic people who started the New Civilisation, without which Palæolithic Man might have remained a useless, destructive brute. No doubt the first white-faced, brown or yellow-haired, grey-eyed Aryans who crossed the Hindu Kush and entered a Negroid, Mongoloid, Australoid India, found elephants roaming all over that vast peninsula without let or hindrance; whereas now they are mainly confined to a few forest districts in the east and south, to Ceylon, and to the Malay Peninsula. Perhaps the invading Aryan, who brought the

horse with him, and, it may be, the northern ox, set to work to domesticate not only the wild cattle of Northern India, but captured young elephants and reared them "out of fun," as is occasionally done by negro peoples at the present day, and, having reared them, endeavoured to turn their strength to some practical account as an engine of war, a living turret for archers, a sentient battering-ram. So, as a great adjunct in warfare, and a royal present from one Eastern king to another, the Indian elephant passed to Persia, Asia Minor, Syria, Egypt, and Carthage. The Egyptians once possessed the African elephant in their own land at the dawn of their history, and later imported examples from the Sudan, but seem to have made no attempt to domesticate this animal. African elephants were imported from Algeria and Morocco, where they still lingered, to Rome for the spectacles of the circus. But the Romans and the Egyptian Greeks found, as others have done, that after arriving at maturity the African elephant is unmanageable.

Of course, in one respect, the elephant, like the parrot, has never become a really domesticated animal, for with very rare exceptions it will not breed in captivity; therefore the supply has to be constantly recruited from the herds of wild animals. This has given man very little opportunity for modifying the race as might otherwise have been possible. If, even yet, we were able to induce the elephant to breed regularly in captivity, what stupendous results might be achieved! If we can make in two or three thousand years anything so splendid as a

cart-horse out of the rough, shaggy, middle-sized horse of Northern Europe, what might we not do with an African or an Indian elephant? Inversely, we could perhaps breed a pony or dwarf elephant, as Nature did during the later Pliocene in Malta.

The camel family originated in North America. Two or



ELEPHANTS HELPING TO BUILD A RAILWAY BRIDGE IN CEYLON



TROTTING MATCH BETWEEN AN OSTRICH AND A HORSE IN AMERICA

Drawn by H. W. Koekkoek, from a photograph by Brown Brothers, New York

three species penetrated in course of time to South America, where they still remain in the form of llamas, huanacos, and vicunias. In North America the whole race died out absolutely before the coming of man, but not before it had exported, by way of Bering Strait, at least one genus, *Camelus*, to North-Eastern Asia. The camel type travelled westwards, and made a new home in Central Asia, where it developed a local species with double humps, the Bactrian camel of to-day. The original type, still passing westwards, inhabited the plains of Southern Russia, the mountains and plains of Asia Minor, Syria, and Mesopotamia, Egypt and Mauretania. It is possible that in the far-back, prehistoric times it even penetrated up the eastern valley of the Nile to the semi-deserts of Gallaland and Somaliland, which it may have inhabited as a wild species till quite recently. The wild camels of Algeria and Tunis died out almost before the advent of man. It is difficult to understand, however, why wild camels should not have lingered on in the Sahara, a country so thoroughly suited to their habits. Apparently, however, after the extinction of the North African camels, with the doubtful lingering of a wild camel in Gallaland, the camel became unknown to Africa.

In Mesopotamia or Syria it was domesticated first about four or five thousand years ago, so far as one can guess from the evidence of monuments. The early Arabs derived it from these regions, and carried the camel with them all over Arabia, and imported it as a domesticated animal into the Abyssinian coast and Somaliland. The ancient Egyptians knew the camel, but not, apparently, at a very early date in their history. It was very slightly employed by them until perhaps the Roman era, and really only assumed its present importance after the Arab invasion. The Hebrews or kindred tribes who dwelt to the west of Egypt, in Syria and Palestine, possessed domesticated camels, as is evident from the frequent references to them in the oldest of the books of Scripture. But the Berbers of North Africa apparently knew nothing about them—whether or

not there were wild camels still in the Sahara—and only employed oxen, horses, or asses as a means of transport. It was not, though the theory may yet be upset by new discoveries, until the great Arab invasions of North Africa, between about A.D. 670 and 1040, that the Berbers of the desert so vigorously adopted the camel in their conquest of the Sahara. The possession of this animal enabled them to cross the Sahara in all directions, and no doubt had a far-reaching effect on the opening up of Negro Africa.

The two-humped camel of Central Asia seems to have been first domesticated, not by the Tibetans or other Mongols, but by the Aryans, or, at least Caucasians speaking Aryan languages—ancestors of the present Persians, Afghans, and Armenians. Eventually, however, the two-humped camel came into use as a domestic beast between North-East China and the Crimea.

The Arabs introduced the one-humped camel into Spain—in a portion of which country it now runs wild—and Arab influence also brought it to Italy in the Middle Ages. The nineteenth century witnessed its range extended to Australia, the United States, and Mexico.

The American camel forms, the huanaco and vicunia, were domesticated by the Incas of Peru, or their still more mysterious predecessors in the same Andean tablelands. This achievement may have taken place four or five thousand years ago. The llama, or tame huanaco, was used chiefly as a beast of burden for transport purposes, and also, to some extent, for food, though the flesh was very unpalatable. But considerable importance was attached to this beast, and a white llama was regarded as a specially fit sacrifice to the gods. The vicunia was tamed and bred for its woolly coat, and in its domesticated form was known as alpaca, or paco. Both these creatures were really domesticated in that they were bred under man's control, and, in fact, so changed and varied under many centuries of separation from the wild stock that until recently they were considered specifically separate, and are, as it is, quite different in colouring.

THE TAMING OF THE WILD

The association of man with the deer tribe has always been rather a close one from Palæolithic times. Venison was good to eat, and deer were more easily run down and killed with the aid of dogs than were horses, and they were not such terrible beasts to tackle at close quarters as the urus or the mammoth. The reindeer of Europe was a favourite quarry of primeval man, whose imagination was much impressed by its form, so that he made it the subject of his interesting drawings and carvings. It may be, indeed, that the domestication of the reindeer began, then, on the verge of the New Birth, the First Renaissance, the Neolithic Period; and that, as the hunter races withdrew northwards before the competition of the new agricultural people, they drove the reindeer before them, and continued to keep them in domestication as beasts of burden and traction, providers of milk and cheese, until at last the boreal regions of Scandinavia, Russia, and Siberia were reached in which the reindeer is, with the dog, the only domesticated animal.

The cat has disdained, one might almost say, to make herself generally useful. The dog sought out man, and thrust itself upon him as a companion; but the cat most reluctantly consented to leave the jungle to become a goddess by the banks of the Nile. No doubt the ancient Egyptians did with their indigenous cat as did the early Hindus with other small felines—picked up the kittens for their attractiveness, and, as they grew up, something in the cat's eyes or nature suggested affinity with one of those spiritual beings by which they personified some

natural principle or force; in this case the goddess Bast (of Bubastis) one of the several manifestations of the great sun-goddess, Isis. Perhaps the large, round, golden eyes of pussy, whose very name is said to come to us from Bast—or from Pasht, another sister and rival goddess—suggested a resemblance to the sun deities. It is also obvious that the cat was a smaller, cheaper, and more manageable substitute for the lioness. Certain Egyptian paintings show that—probably under severe compulsion—the cat so far demeaned herself in some families as to become useful as a huntress and a retriever of birds. It was, however, somewhere about the time of the Greek invasion of Egypt that the cat attracted special attention as a vermin-killer. About that period Northern Egypt began to experience the beginnings of the rat invasion, which, from the little we know, came out of Central Asia to vex all the world. The house mouse has been in Europe, Asia, and Africa for many thousand years, but probably did not become a nuisance till men and women had grown particular about their homes, and thrifty as to their granaries. It caused great annoyance, however, in Egypt, Greece, and Rome for some hundreds of years before the Christian era. The Greeks and Romans tamed—perhaps domesticated—the marten, and employed it to rid their houses of mice, calling it respectively by names which they subsequently applied to the domestic cat. The Egyptians, however, found their sacred African cat to be a splendid mouser. Wild Egyptian cats were exported to Syria, Persia,



GROUP OF OSTRICHES ON AN OSTRICH FARM IN SOUTH AFRICA

From a photograph by J. Russell & Sons

Asia Minor, Greece, and Rome, and founded the world's stock of the fireside friend.

It is impossible in the space at my command to enumerate in detail the lesser triumphs of man in the domestication of animals. I can only allude to his creating breeds of domesticated carp, such as goldfish, veiled-tail fish, telescope fish; insects, like silk-producing moths, dye-yielding coccids; birds for exhibition, plumage, food, or song; the domestic fowl, peacock, turkey, guinea-hen; the ostrich, goose, duck, swan; the pigeon, turtle-dove, and canary-finch; rabbits for food and fur; guinea-pigs, rats and mice, for toys; and polecats, in the form of ferrets, for destroying vermin.

So far we have confined ourselves almost entirely to the animals that have been domesticated by man, that is, brought so much under his control that they have bred in confinement under his supervision, and in most cases have permitted him so to regulate their multiplication that he has created new types by deliberate selection in mating, and by altering the conditions of life. In these achievements, as in his agriculture and horticulture, he has had to fight recalcitrant Nature. No sooner has man attempted to invade a new district with his animal serfs than for them, as for him, there have sprung up scores of foes, chiefly invisible to the naked eye: germs, fungi, protozoa, bacilli, intestinal worms, and insect or spider parasites. Or the food has not suited, or the climate, or carnivorous birds and beasts have disputed possession and increased his labours.

Especially has it been when he has achieved his initial great success in some experiment that the blow falls. The silk trade brought about an immense aggregation of silk-spinning caterpillars in France in the early part of the nineteenth century. Consequently there broke out the terrible silkworm disease, which threatened to annihilate the whole lot. The history of Pasteur's patient struggle

and his final triumph is one of the romances of science. The various cattle plagues, originating in Africa, threatened to denude the Old World of oxen, and annihilated something like a million of these indispensable creatures at different times in Africa alone. But a way round was found, a cure, a prophylactic; and here we have triumphed over and over again with the resources of science. In the same way we are conquering the diseases spread by the tsetse fly, by the mosquito, by the tick, and by intestinal worms.

But besides the domesticated beasts, birds, fishes, and insects, there are many creatures which have been made man's servants in the individual, though they have refused to beget offspring in his keeping and so permanently enslave their race. The elephant to a great extent should really be included in this class, because when man wishes to recruit fresh conscripts he has to capture them in the forest. Still, the Indian elephant does sometimes breed in captivity, and freely in semi-captivity; and it is quite possible that the African elephant, humoured a little as to surroundings, might do the same. But the parrots usually refuse. No parrot has become truly domesticated except the *Melopsittacus* parakeet. Yet there are signs that this bird-equivalent to the monkey is yielding, as witness the nesting which is going on in the out-door aviaries at the Zoo. If I were a millionaire I would attempt to breed macaws in a vast aviary, and carry the eyes of mankind to extreme developments of colour as yet undreamt of.

The great apes, so far—though they are often tamed—have never brought forth young in captivity. Monkeys breed freely in menageries, but something has hitherto prevented mankind from domesticating his nearest relations on the animal side. The ancient Egyptians apparently tamed the baboon and trained it to ascend palm trees and



TEAM OF SIX OXEN WHICH ARE DRIVEN AS HORSES BY AN AMERICAN



LIONS IN CAPTIVITY ARE BRED AS FREELY AS IN THE OPEN
From a photograph of a group of lions in the Dublin Zoological Gardens

throw down the fruit. But there is silence in research as to the final results of this experiment. At any rate it came to nothing, for the baboon is still a wild gipsy of the desert and the bush.

In Western and Central Asia men first conceived the idea of utilising birds of prey as food-getters. Young hawks, falcons, and even eagles were taken from the nest, tamed, dressed, and "flown" at birds and beasts, from quails to bustards, hares and marmots to antelopes and deer. But they were never induced to procreate young in captivity, and always had to be recruited anew from the ranks of the wild. So they gave birth to no modifications under man's control. Likewise, the great chita, an aberrant hunting cat, was, and is, often tamed as a cub by natives of India and Somaliland—though no use is made of it there—and employed to hunt down antelopes. But, curiously enough, it very seldom breeds in captivity.

On the other hand, lions breed as freely in a cage as in the open—tigers less so, leopards and jaguars and pumas very seldom—and there is no want of inclination on the part of the lion to join the tide of human society. In Egypt, in Senegal, in Mesopotamia, perhaps once in India, he has been tamed and allowed his liberty, apparently without disastrous consequences, if he or she were regularly fed. The same thing has occurred less markedly with the tiger. But the chita, puma, and the ounce of Central Asia are superior to these large felines in their placable temperaments and the complete absence of danger to human beings in their domestication, which might be more actively pursued.

The otter has been tamed in India and taught to catch fishes for its master, but does not breed in captivity; and this is true also of the cormorant. In Japan and China, as of old in Britain, the cormorants fish for the people who train and keep them, but do not breed up young to similar service.

The nilgai is tamed by the Hindus, and seemingly breeds without reluctance in a captive state; yet somehow this large, handsome beast has not become a domesticated animal like the ox and buffalo. The webs of certain spiders, the cocoons of some moths, the flesh of many species of crabs, crayfish, and lobsters are utilised by man for his manufactures or his choicest food, yet the producers have never been domesticated like the coccids, the silkworm moths, the oyster. We have domesticated the trout and the carp, and the climbing perch, but not as yet the unspeakably lovely parrot fishes, the sea bream, or even the salmon or the sturgeon. Yet from what I have seen in that most wonderful of all existing aquariums, at the Battery, in New York, it is conceivable that in a millionaire's house, with a sufficiently large atrium, sharks may yet become household pets and sturgeons be kept on the premises to produce fresh caviare.

Indeed, having done so much since the Improved Stone Age, we demand to know why now, with our enormous advantages over Neolithic Man, we do not do more. Why do we not domesticate and breed in large herds the bushbuck? If there is one meat in the world more delicious than another, something which is like the perfection of Welsh mutton, it is the meat of the bushbuck, of various species, all over Africa. The Negro, we know, has practically domesticated nothing; he has simply accepted the domestic animals of the European and the Asiatic. Still, why should not the many civilised Negro peoples of Africa to-day, and the still more enterprising white races, try to preserve and domesticate the bushbuck? And the eland, still more so? And the kudu? Why has it been so easy to domesticate the ox and so difficult to domesticate the African buffalo? Why should the Indian elephant have been turned to man's purposes in Asia 5,000 years ago, and the



LLAMAS TRAINED FOR RIDING



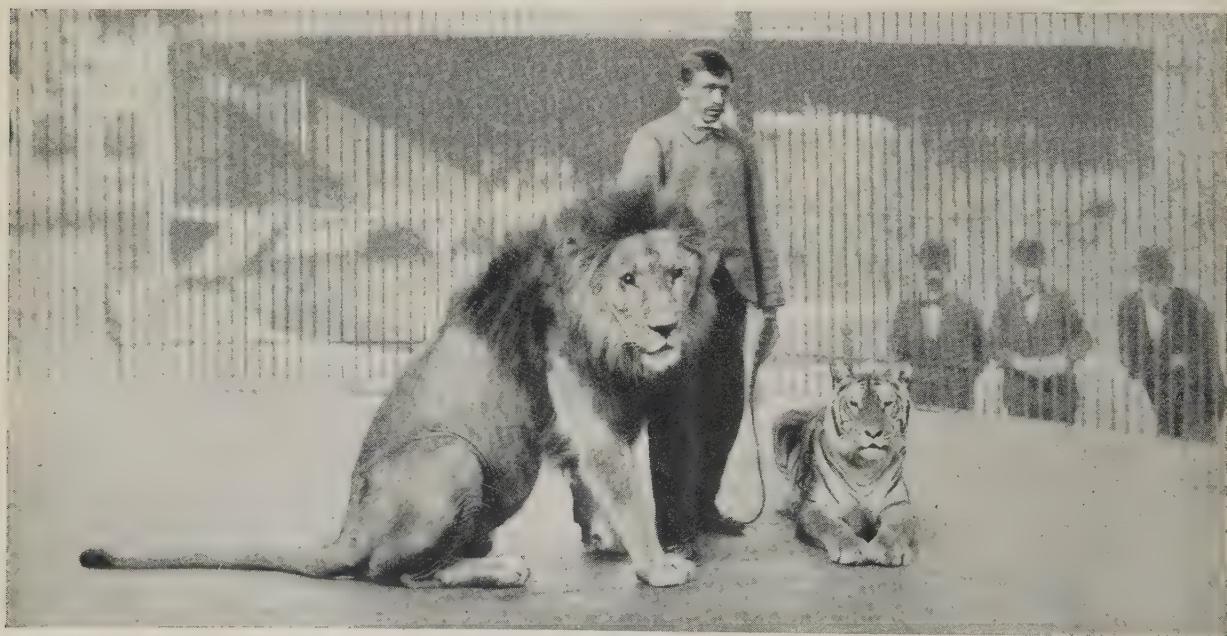
A PIG TRAINED TO DRAW A CART

African elephant be still an unreclaimed wild beast, except in one tiny corner of the Belgian Congo? Why can we breed so easily the wild Madeira canary in cages and aviaries, and not the much more beautiful English goldfinch? These are questions which mankind might set themselves to solve, in order to increase the varied food products and utilitarian resources of the world, and, above all, to add to our store of beauty and wonderment.

As we review the past of man's taming of the wild, we seem to see one principal agency initiating these achievements—that mysterious Neolithic, or possibly Aryan, renaissance of man: the wonderful White man, almost, in his effect on the history of the world, like some special inbreathing of a Divine spirit. He seems to have arisen in some region north of the Caucasus, and to have spread across Central Asia, after becoming the dominant race in Europe and North Africa, till he reached Korea and Japan, where his vestiges remain, in the shape of the Ainu and the semi-Caucasian Japanese. He permeated

the north of China and something of Tibet, and penetrated through the jungles of Burma till he reached Southern Siam, the Malay Peninsula, Sumatra, and Polynesia. In a much diluted form, by way of the Aleutian Islands, he reached North America; perchance also he may have got to South America by way of the Pacific archipelagoes and have started such original civilisation and taming of the wild as made their separate manifestations there. He turned the sub-continent of India from a vast forest of mainly Negro savagery into, at one time, the most civilised region of the world. From Egypt and from Mauretania he penetrated Palæolithic, utterly barbarian Africa; and gave the Negroes most of their languages and arts, domestic animals and religious ideas. Perhaps, therefore, he is the primal inspirer, or God's great channel of inspiration. At any rate, the White man, since the beginning of the Neolithic Age, has been the chief, if not the only, agency in this Taming of the World.

H. H. JOHNSTON.



LION AND TIGER IN CAGE WITH THEIR TRAINER IN CARL HAGENBECK'S MENAGERIE



THE BLUE-AND-YELLOW MACAW

"British Guiana has splendid macaws, the blue-and-yellow species presenting one of the finest examples of brilliantly contrasted colouring in Tropical South America."—*Sir Harry Johnston*



THE DUCKBILL OF AUSTRALIA

"The platypus has been regarded as the most curious of the egg-laying mammals—the duckbill, in Australia and Tasmania."

—Sir Henry Sladen



A GROUP OF FLAMINGOES

The rosy Flamingo is one of the sights of the Bahama Islands in the British West Indies. —*Sir Harry Johnston*



POLAR BEARS IN THEIR REALM OF ICE AND SNOW

'Within striking distance of the unconscious seal, the Polar bear kills its quarry with a blow of its ponderous paw.'—*Aubyn Trevor-Batye*

GEOGRAPHY OF THE ANIMAL WORLD

DISTRIBUTION OF WILD LIFE IN TIME AND PLACE

By ALFRED RUSSEL WALLACE, F.R.S.

THERE is probably no branch of natural history about which so little information is given in popular works as that which discusses, and very largely explains, the causes of the varied and apparently erratic distribution of animals over the earth's surface. Yet there is none which to the general reader is so puzzling, and to many so interesting. This is partly due to the fact that the complete explanation is not only fundamentally based upon the laws of evolution, but that it requires also a frequent reference to the facts of geology and palæontology, and to many comparatively recent discoveries in physical geography.

Darwin himself laid the foundations of the study by his observations and deductions as to the total absence of both mammalia and amphibia from oceanic islands, and also by his extensive experiments and observations on the modes of dispersal of plants and animals; and it is only by combining all these sources of information with those of recent inquirers as to the nature of the deposits in the deep oceans that any intelligible view of the subject has been arrived at.

It may be as well first to state briefly some of the curious facts and apparent anomalies that have to be explained. Why, for instance, are deer entirely absent from Africa—except on the southern shores of the Mediterranean—though found over the whole of the other great continents from Patagonia to Greenland and from Britain to Japan? Why are camels found only in the great desert-belt of North Africa and Central Asia, and their nearest allies, the llamas and alpacas, only in the Andes south of the Equator and in Patagonia?

The old idea that animals are found where the conditions are fitted for them is disproved by the fact that the entire horse tribe is now limited, in a wild state, to Africa and Asia, but when introduced into both North and South America by the Spanish conquerors they ran wild and increased enormously. Most extraordinary is the case of the curious tapirs, animals something like small rudimentary elephants, of which two or three species are found in Tropical America, and the only other species—the Malayan tapir—in Borneo and the

Malay Peninsula. Among birds we have the humming-birds swarming all over America from Patagonia to Labrador and Alaska, but in no other part of the world. The equally wonderful birds of paradise, of which about fifty different species are now known, are found only in New Guinea and a few adjacent islands. Lastly, we have the great mammalian order of Marsupials, limited to Australia and the adjacent islands as far as Celebes and the Moluccas on the one hand, while one family of the same order, the opossums, abounds in South America and as far north as California and Virginia.

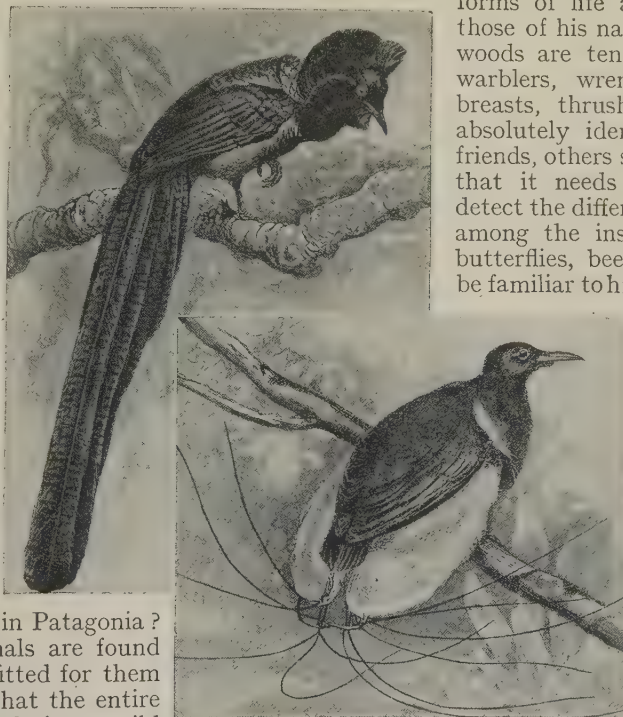
We may also look at these differences from another point of view—that of the similarity of the animals in countries far apart, and the diversity that is often found between those which are comparatively near together.

If a person travels by any of the ordinary routes from England to Japan or the Amur, he will have gone very nearly half round the globe; yet when he reaches those remote countries he finds in the forms of life a wonderful similarity to those of his native land. The fields and woods are tenanted by titmice, hedge-warblers, wrens, wagtails, larks, red-breasts, thrushes, and buntings, some absolutely identical with his feathered friends, others so nearly resembling them that it needs a close examination to detect the difference between them. Even among the insects he will notice many butterflies, beetles, and so on, that will be familiar to him, though they may prove

to be distinct species. In the Amur valley he will find even the mammals to be very similar. The fox, the badger, the weasel, the otter, the roedeer, the hedgehog, the mole, the squirrel, and the Irish hare, are all the very same as the British species; while the wolf and the bear are identical with those that inhabited the British Isles within the historical period, and are still common in Europe.

But if a settler in Australia goes to New Zealand, a distance of

about 1,300 miles, he finds himself in a country zoologically and botanically entirely unlike the country he has left. Kangaroos, wombats, and the other varied forms of marsupials are absolutely wanting. There are no wild mammalia except two



TWO WONDERFUL BIRDS OF PARADISE

These birds number about fifty species and are confined to New Guinea and the adjacent islands. The top picture represents the Gorget, and the lower the Twelve-wired species

kinds of bats; the birds are almost all quite new to him; while insects are very scarce and altogether unlike the many handsome or curious species found in his own country.

Even more remarkable, perhaps, is the case of two small islands, Bali and Lombok, in the Malay Archipelago, only fifteen miles apart, yet strangely different in their productions. Their birds differ more than do those of Britain and Japan. Bali has red and green woodpeckers, barbets, weaver-birds, black-and-white birds like large wagtails, and many others quite unknown in Lombok, where we find screaming cockatoos and friar-birds with bald heads, and the strange mound-building megapodes, all allied to Australian species and entirely absent from both Bali and Java. Again, the great island of Borneo is much more like Sumatra and the Malay Peninsula, both in its mammals and birds, than is the much nearer island of Celebes, whose productions are more nearly allied to those of India or Africa.

Now, these and most of the other peculiarities in the distribution of animals are either directly explained or rendered intelligible by the application of the facts and general principles already enumerated; and I therefore propose now to explain as clearly and simply as possible the nature of those principles, which, when once thoroughly understood, will afford the means of solving almost all the problems of distribution both of plants and animals.

PERMANENCE OF OCEANIC AND CONTINENTAL AREAS. I begin with what is perhaps the most fundamental and far-reaching of the phenomena on which the interpretation of the existing distribution of plants and animals depends, the true importance of which was first perceived by Darwin.

Before the "Origin of Species" appeared, the common belief was that almost all the islands scattered over the great oceans were the remnants of former continents which had sunk beneath the waters, while our existing continents rose up to take their place. This view was accepted almost as a matter of course, and seemed, at first sight, to be quite in accordance with the fact that most of the older rocks in all parts of the world were of marine origin. But, during the voyage of the *Beagle*, Darwin was able to visit many of these islands, and he was struck by the poverty of their forms of life.

He also noticed the fact that all of them were either volcanic or of coralline formation, and they never contained any of the stratified rocks characteristic of continents and of islands that have once formed parts of them. He therefore concluded that they had all been formed in the ocean itself, though some of them appeared to be very ancient; and the total absence of native land mammalia could thus be easily explained, as these animals, though often good swimmers, could never cross wide seas or oceans. He further showed by experiment that the eggs of batrachians (frogs, newts, etc.), which were equally wanting, were quickly killed by salt-water.

Some years later, when electric cables began to be laid across the oceans in various directions, and when the voyage of the *Challenger* showed us the contour of the ocean floor and the nature of the deposits forming upon it, a striking confirmation of Darwin's views was obtained. For it was then for the first time shown that the floor of the great oceans did not form hills and valleys and mountain ranges, as had often been assumed; but was really an enormous, slightly undulating plain at a depth of from ten to thirty thousand feet, out of which plain the continents and islands usually rose abruptly; so that the 100-fathom line closely approached their shores, and even the 1,000-fathom line only left a narrow belt around them, in no way altering their general outline.

Most important consequences result from these facts. Sir John Murray, of the *Challenger* expedition, has calculated that the mean height of the land of the globe is 2,250 feet above sea-level, while the mean depth of the ocean is 13,860 feet below it. But the area of the land is little more than one-third that of the oceans, whence it follows that the bulk of the oceans in cubic miles is more than thirteen times that of the land. In my "Darwinism" (p. 345) I have given a diagram, showing at a glance these proportions; and I pointed out, I believe for the first time, that these great differences



THE VIRGINIAN OPOSSUM

This is the only marsupial that exists outside Australia and the adjacent islands

in the bulk of land and water rendered it almost impossible for any interchange of continents and oceans to have occurred during geological time. There must have been some approach to equality in the simultaneous rising and sinking of the solid crust of the globe. But if one of our smallest continents were to subside, and an adjacent portion of the ocean floor on either side of it to rise, the former would almost wholly disappear before the latter had approached within many thousand feet of the surface. And if a similar change went on successively, one

continent after the other would sink, while the counterbalancing rise would hardly have rendered the vast extent of ocean any shallower than it was before. The contour of the ocean bed, and the comparative bulk of land and water, alone serve to indicate that the great and often-repeated vertical movements of the land over all the continents throughout geological time must have occurred within or on the margins of the areas they now occupy. If they had not been thus limited, if the gigantic forces of elevation and depression which have been always at work in the continents had been also at work beneath the ocean floors, the latter must have exhibited some of the abrupt inequalities of the former, instead of being entirely different from them in their contours.

These conclusions are quite in accordance with the broad features of stratigraphical geology in every part of the world. Everywhere we find the successive strata of which the earth's crust is formed occurring in long, irregular, but more or less parallel belts overlapping each other; and in numerous cases exhibiting intercalated land surfaces or fresh-water deposits. This may be well seen by looking at any large geological map of England, or of any part of the Continent. This feature is perfectly explained by the minute examination that has now been made of the ocean floor near the land, as well as across its greatest depths. It has been found that the larger part of the débris of continents brought down by rivers is deposited mainly within a distance of from 50 to 100 miles from the coasts, while the very finest mud, which, of course, sinks more slowly, is deposited within 150 miles, and only in rare cases extends so far as 200 miles. All these are termed "shore deposits," and they form, when consolidated and uplifted, the successive strata of the earth's crust.

But beyond these limits, and extending for thousands and tens of thousands of miles over the whole floor of the deep oceans, is found a very different set of deposits termed "oozes." The most extensive is that termed globigerina ooze, because it consists very largely of the shells of a minute organism of that name, and it is found at almost all



THE TREE KANGAROOS

This species of tree-inhabiting marsupials is only found in the dense tropical forests of New Guinea and Queensland

depths from 250 to 2,000 fathoms. The remains of many other surface organisms occur among it, as well as of those that live at the bottom; but no true land débris. There are, however, numbers of volcanic particles, either derived from pumice, which floats for enormous distances, or from volcanic dust carried by the wind, which in the case of the Krakatoa eruption fell on the decks of ships nearly

1,000 miles from the volcano; while, what is still more extraordinary, a small proportion of meteoric dust can always be found. This gives an idea of the extreme slowness with which the oozes are formed, since such dust can hardly ever be detected on land. Another indication of the same thing is the large number of sharks' teeth, and the ear bones of whales, the only parts of these animals which escape complete disintegration.

In these vast areas of deep-sea oozes covering the whole ocean floor we have another contributory proof that oceans and continents are not interchangeable. For if they had been so, as many writers still suppose, then each upheaved continent must rest on a basis formed of such consolidated oozes, with their characteristic fossils and inorganic particles. Yet in not a single one of our continents has any such base-rock been found, while our greatest geologists are almost unanimous in declaring that such consolidated oceanic oozes occur nowhere in the whole series of strata in any part of the world.

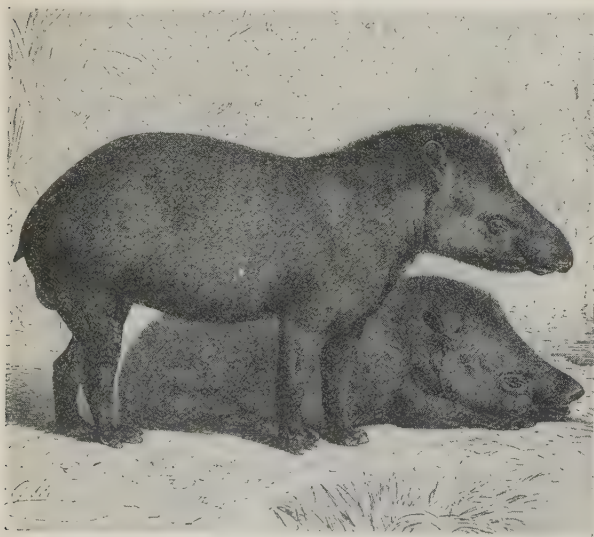
It is a very suggestive fact, as indicating that the law of subsidence balancing elevation is a real one, that all the greatest depths yet found in the ocean are in the vicinity of lofty volcanoes or ranges of mountains. Thus a depth of 23,250 feet has been found a little north of Porto Rico, West Indies; 21,930 feet a little south of the Aleutian Islands; 27,930 feet a little north-east of Japan; 18,140 feet a little north of the Sandwich Islands; 19,000 feet a little north-west of Bermuda. Very few of these very deep soundings have, however, been taken, as they are exceedingly laborious and costly.

The conclusion, therefore, of many of our greatest geologists, that the whole series of the stratified rocks present evidences of having been formed near to land, is supported by so many weighty arguments, derived from various sources, that it must be considered to be a well-established deduction of science.

Yet we still find many palæontologists insisting on land connections across the deepest oceans in order to explain similarities in their extinct animals. But there are other ways of explaining such facts much more in accordance with probability, and with the great generalisation I have here indicated.

EXISTING CONTINENTS AND THEIR PROBABLE EXTENSIONS. If we look at a globe or a map of the world in hemispheres, and consider the position of the continents and larger land masses, we find that they, even at the present time, are wonderfully connected; that it would be actually possible for a man to traverse the whole of the continents, starting from Cape Horn, without ever going out of sight of land or requiring any other vessel than a small open sailing-boat. If we now look at a map showing the 1,000-fathom line around all the continents (such as that given in my "Darwinism"), and taking this as roughly indicating the amount of extension of the land during the whole Tertiary period of geology, we shall find all the continents united towards the north by wide stretches of land, offering ample facilities for the migrations of land animals at successive epochs.

WARMER CLIMATES IN PAST GEOLOGICAL PERIODS. But there is another consideration which is continually left out of account by those who still claim direct land connections to account for real or supposed affinities of the extinct animals of South America and South Africa, and that is the much warmer climate that prevailed in northern and Arctic regions throughout Tertiary times, and even very much earlier. This is proved by abundant remains of fossil plants found in Miocene strata all round and within the Arctic Circle, and of such a character as now grow a long way further south. On the west coast of Greenland, in 70° N., are beautifully preserved specimens of such trees as chestnuts,



THE AMERICAN TAPIR



THE MALAYAN TAPIR

The tapirs were distributed over North America, Europe, and Asia in the ages when these lands were warmer than at present. Four species are now found in Central and South America and one in the Malay Peninsula, Sumatra, and Borneo. None is found in any other part of the world



THE LLAMA OF SOUTH AMERICA



THE BACTRIAN CAMEL OF CENTRAL ASIA

These two animals are allied in all essentials of structure, even to the peculiar stomach adapted to water-storage. They are to-day as remote from each other as are the tapirs, and have no kin between South America and the desert regions of North Africa and Western Asia

sassafras, oaks, planes, beeches, plums, vines, and even a magnolia, all closely resembling trees and shrubs which now grow 20° or 30° further south in North America. Even so far north as Spitsbergen, one of the most barren and most inhospitable regions on the globe, a rich fossil flora has been found, indicating a climate fully as mild as that of the warmer parts of Canada at the present time, comprising such familiar plants as hazel, ash, and walnut, with water-lilies and an iris. As there was probably continuous land between Europe, America, and Asia, at least as low as the latitude of Stockholm, while the land a little further south had a warm temperate climate, it became possible for every kind of mammal of the temperate zones and many of the Tropics to migrate from one continent to the other.

There is also evidence that still warmer climates prevailed in the Cretaceous period, and, therefore, almost certainly in the early Tertiary, when all the chief types of mammalian life were well developed. In strata of this period in Greenland, not far from those of Miocene age above referred to, not only many of the trees of the later period occur, but, intermingled with them, such indications of warmer conditions as figs, myrtles, cycads, and tree-ferns. The only justification for postulating direct communication is that a shorter route is more effective, and therefore more probable, than a longer and more circuitous one. But this argument supposes two things which no geologist will admit—first, that the geological record itself is at all near to a full and continuous one; and, secondly, that our knowledge of the actual record approaches to completeness. It is, on the contrary, held to be certain that the record of the animal life of all former periods contained in the rocks is extremely imperfect and fragmentary, and that our knowledge of

what exists, much of it buried deep in the crust of the earth, is wholly inadequate.

It is interesting to note that the very changes in the height of land and elevations of sea-bottoms in the northern parts of the Atlantic and Pacific oceans, which would facilitate the migration of land animals between the eastern and western continents, would themselves greatly assist in the production of the warm climates we find proofs of. It is universally admitted that warm ocean currents, aided by the warm winds that carry moisture from them, are the great sources of the mild and equable climates that even now prevail in many parts of the north temperate zone. The British Isles, as well as Norway, owe their mild winters to the Gulf Stream and the warm and moist westerly winds that are so prevalent; while Labrador, in the same latitude, has a thoroughly Arctic climate, due to its being washed by a Polar current, and being exposed to cold winds from the Arctic regions of America.

But when the North Atlantic was elevated about 1,000 fathoms, the heating power of the Gulf Stream would be greatly augmented by two causes. It would be more concentrated by being kept out of the Polar seas, and would circulate more rapidly around the northern shores of the Atlantic. It would also be completely free from the Arctic icebergs which now pour into it as soon as the ice breaks up in the Polar basin, causing that wintry weather which is regularly experienced in Great Britain during the first half of May. And when such a mild climate prevailed as is shown by the abundant tree and shrub vegetation within ten degrees of the Pole, there would probably have been very small accumulations of ice, which would have no more serious effect on the climate than have the glaciers of Switzerland or of New Zealand in their respective cases.

EVIDENCE OF STILL EARLIER WARM ARCTIC CLIMATES. Before quitting this part of our subject, it will be well to note the abounding evidence of equally warm climates in the northern hemisphere throughout much, if not all, the Secondary period of geology. I will first notice the suggestive fact that, even more recently than the Cretaceous beds of Greenland above mentioned, in the London Clay (Eocene) of Sheppey, Bournemouth, and a few other localities, abundance of fossil plants has been found closely allied to living tropical or sub-tropical forms. Fruits of palms allied to those of the *Nipa* of Indian and Bornean river swamps are frequent, as well as the fruits of a proteaceous plant whose allies are now found in Australia. There are also species of acacia and anona, both warm-country forms; and, associated with these are found teeth and bones of crocodiles, a large sea-snake, and several mammals of the hog and tapir tribes. There are also numbers of marine shells now characteristic of tropical seas, including the nautilus.

Throughout the Secondary period similar conditions appear to have prevailed, the sea-shells being, both in size and structure, almost wholly of the type of those now confined to the Tropics. The abundance of large and often gigantic reptiles—terrestrial, marine, and aerial—which are found in these strata throughout Europe and America are equally indicative of tropical conditions. And these conditions must have prevailed also within the Arctic Circle, since the very early Triassic strata of the Parry Islands, in 77° N., contain many ammonites as well as the vertebræ of the large marine reptile ichthyosaurus; while, in the Triassic beds of Spitsbergen, ammonites and nautilus are found, and still earlier in the Coal Measures of that country are lepidodendrons and large fronded ferns.

We thus see that during the whole range of geological time between the Middle Tertiary and the Carboniferous ages there is almost continuous evidence of such mild and uniform climates far into what are now Arctic lands as would suffice for the temporary residence and continuous migration of most tropical animals between the Eastern and Western continents. No adequate reason, therefore, can be given for assuming an enormously difficult if not impossible bridging over of the great oceans, in order to account for the existing distribution of animal life; and still less in order to explain its apparent distribution in remote geological ages, as to the whole conditions of which we have such very scanty and imperfect knowledge.

Even now many wholly tropical animals live very well and breed freely in the whole temperate zone, such as domestic fowls and peafowl; while monkeys are found as high as 11,000 feet in parts of the Himalaya. As late as the Pliocene period they lived in France and Britain. Even the hippopotamus, an almost tropical animal now, inhabited South Europe, and ranged as far north as Yorkshire during the summers of the Glacial period!

THE POWERS OF DISPERSAL OF ANIMALS. The distribution of animals over the earth's surface

of course depends in part upon their individual powers of locomotion—on land, through the waters, or through the air—but this is by no means the only factor of importance in determining their actual habitations, and is often entirely neutralised by other causes. In most continents, and in many of the larger countries or islands, birds exhibit a very similar restricted range to mammals, notwithstanding their very superior powers of locomotion. Reptiles also exhibit little difference in this respect, except that they are more dependent on temperature and become scarce in temperate and almost absent from very cold countries. The amphibia—frogs, toads, newts, salamanders, etc.—are in some respects more restricted than reptiles in their ranges, and more extended in others. This is due to the fact that they can withstand a lower temperature, their eggs being often frozen without injury; but, on the other hand, they are killed by salt water, and this explains the interesting fact that they, as well as mammals, are wholly absent from all true oceanic islands. This class of islands may be defined as being situated in the great oceans far from any extensive land masses, and being surrounded by depths of more than a thousand fathoms. All such islands, as was first pointed out by Darwin, are entirely without any of the older stratified rocks, consisting either of volcanic rocks or of coral formations which have been deposited upon them. Such are the Azores, Madeira, St. Helena, Mauritius, and all the remoter islands of the Pacific Ocean, none of which possesses either mammalia or frogs, and the most remote from land no reptiles or freshwater fishes. These are entirely absent from the Azores and St. Helena, while the Sandwich Islands possess two lizards—one very widespread over the whole western Pacific, and therefore presumably conveyed accidentally in canoes; the other a peculiar gecko, whose ancestors were probably introduced at some remote epoch by exceptionally favourable circumstances, such as large floating trees from more westerly islands. Within the Tropics especially, masses of trees and floating vegetation are often carried out to sea, and under favourable conditions may be driven by winds and currents for many hundreds or even thousands of miles, and carry with them small lizards or their eggs, insects, and land shells. These latter often hide in crevices or under bark, while some snails, when dormant, will stand immersion in salt water for twenty days without injury. We thus see an explanation of the curious fact that in the remotest islands, even when every kind of vertebrate except birds is absent, a few land shells and terrestrial insects, especially beetles, are always to be found.

But the more remote the island, and therefore the rarer and more exceptional the chances that bring these latter creatures to it, the more peculiar we find the existing species to be. Thus, in the very remote Sandwich Islands, with their rich vegetation and favourable climate, there are about 500 different kinds of land shells, almost the whole of which are peculiar species; and the moderately rich insect fauna is equally peculiar. In the Azores, however,

CORMORANTS AND PELICANS IN THEIR NATIVE HAUNTS



A COLONY OF BROWN PELICANS NESTING ON THE BANKS OF INDIAN RIVER, FLORIDA



BRANDT'S CORMORANTS IN THEIR HAUNTS ON THE ROCKS OFF MONTEREY, CALIFORNIA
From reconstructed groups in the American Museum of Natural History, New York

which are less remote from the nearest continent, and much more subject to violent storms—bringing numerous birds which are both seed and shell carriers—shells and insects are less numerous, and a much larger proportion belong to European forms.

All the facts connected with these oceanic islands, some of which form groups of great extent and of considerable geological age, and are scattered over all the great oceans, strongly support the view that the oceans themselves are permanent features of the earth's surface; while the complementary fact, that the great continents in their main features and position are equally permanent, is demonstrated, first, by the occurrence in all of them of an almost identical series of stratified rocks of all the geological periods, and, secondly, because these rocks everywhere show plain indications of having been deposited very near the margins of the lands from the denudation of which they have been built up.

With the amount of preliminary knowledge here sketched out, we are in a position to explain most of those curious examples of discontinuous distribution which often appear so puzzling.

THE DISTRIBUTION OF TAPIRS. One of the most prominent of the puzzles of distribution to the earlier naturalists was that of the tapirs, the two commonest species of which inhabit Tropical South America from Brazil to Paraguay, and the Malay Peninsula, Sumatra and Borneo. Three other species also inhabit Tropical America, one in the high Andes and two in Central America from Panama to Mexico; but none is found either in Africa or continental India.

But the course of geological discovery during the nineteenth century has completely explained this apparent anomaly. First, in 1825, Cuvier described the skeleton of the *Palæotherium* from the early Tertiary beds of Paris as being allied to the living tapirs; and later, both in France and Germany, the remains of true tapirs were found in the middle Tertiary (Miocene) and late Tertiary (Pliocene) strata, both in France and England. Fossil tapirs have also been found in China and in North America from Carolina to California.

Now, always keeping in mind the extreme imperfection of the geological record, these discoveries clearly indicate that many species of tapirs inhabited warm and temperate Asia, Europe, and North America in middle and late Tertiary times. But during these epochs warm and even sub-tropical conditions prevailed in the Northern hemisphere as far as the Arctic Circle, accompanied by an abundant and luxuriant vegetation; and we have also seen that these conditions were probably brought about, in part, by a greater extension of land in the North Atlantic, admitting of more or less easy communication between the Eastern and Western hemispheres. The problem of the tapirs is, therefore, completely solved.

DISTRIBUTION OF THE CAMEL TRIBE. The case of the camel is perhaps even more interesting than that of the tapirs, which it somewhat resembles. Camels

are now inhabitants of the desert regions of Western Asia and North Africa, and of no other parts of the world. But in the Andes and temperate plains of South America is a group of small animals—the llamas, alpacas, and guanacos—which in all essentials of structure, even to the peculiar complex stomach adapted for water-storage, belong to the camel tribe. These two allied groups are, therefore, now almost as remote from each other as are the American and Malayan tapirs, with no allies whatever in intervening regions. But here, too, geology has furnished the solution. First, in the late Tertiary deposits of the Siwalik hills of North-west India remains of true camels have been found; but, during the last thirty or forty years, a wonderful series of fossils has been discovered in North America, in late, middle, and early Tertiary strata, by which the whole gradual development of camels from a smaller and more primitive type has been exhibited.

The same strata have shown us early forms combining the characters of all the hoofed animals, from the swine and the hippopotamus to camels, cattle, deer, sheep, and antelopes, gradually becoming specialised into those varied forms. It is, therefore, clear that in all probability the camel and llama tribes originated in the Central United States, where, towards the end of the Tertiary period, they became extinct. Previous to this catastrophe, however, some of the true camels migrated to the Eastern hemisphere, probably by the way of continuous land in the North Pacific, and have left as their only survivors the camel and the dromedary. About the same time, and probably driven to migrate by the same adverse conditions which led to the extinction of so many of their allies, the llama group passed southwards along the central mountain ranges into South America, where they have found suitable conditions for their survival south of the Equator, in the high Andes, and on the arid plains of Patagonia. Here, again, the problem is satisfactorily solved.

THE DISTRIBUTION OF THE HORSE TRIBE. The horses, asses, and zebras constitute a distinct and very remarkable tribe of mammals, being the only members of that great class which possess a single functional toe on all four feet, forming the well-known horse's hoofs. These animals are now strictly limited in a wild state to Africa and Western Asia, though in quite recent times they ranged over Europe and the British Islands; and many allied groups are found in still earlier times, back to the early Tertiary, showing the gradual transformation of a four-toed animal of small size, step by step, into the true one-toed horse.

But, what is more curious still, a similar and even more complete series of ancestral forms existed in North America, where the true horse was also developed, its fossilised remains being found over both North and South America nearly up to the Glacial period. Then suddenly all became extinct. But after the great Ice Age had come and gone, with the many changes of animal life that accompanied it, the two continents again became well adapted

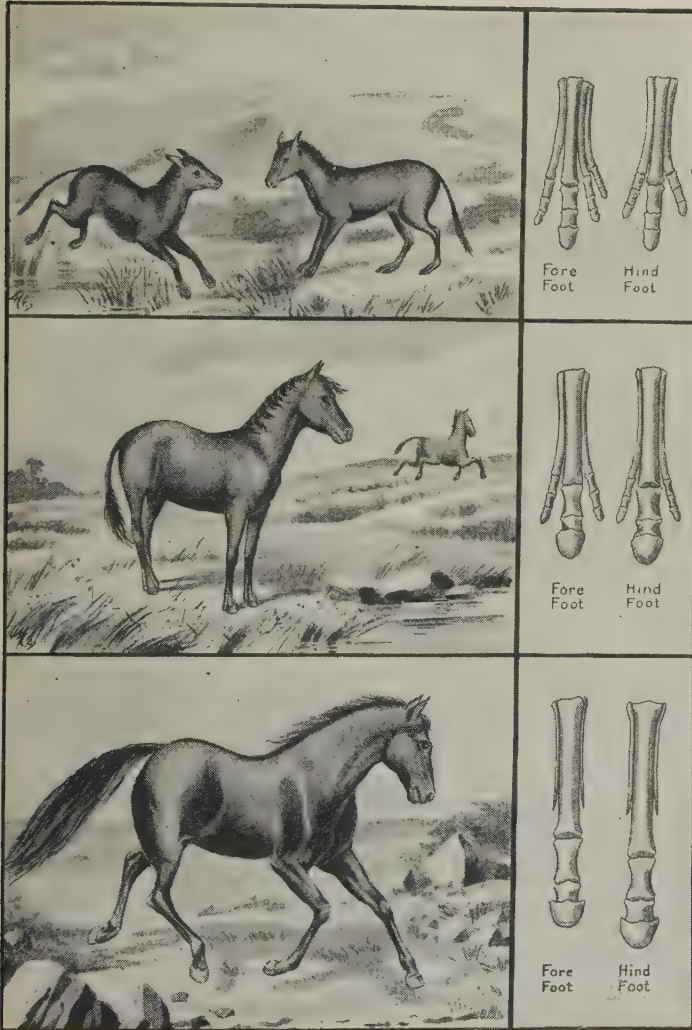
GEOGRAPHY OF THE ANIMAL KINGDOM

to horse life, as proved by the fact that, as we have said, when introduced by the early Spanish conquerors they ran wild, and increased enormously both in the western plains of the north, and in the llanos and pampas of the south.

It is curious that the series of these ancestral horses runs almost parallel in America and Europe, though the species are not exactly the same; and this seems to imply that the North Atlantic land connection existed for a long period, and that inter-communication from America to Europe and from Europe to America frequently occurred. It is, in

mild climates as are indicated by other evidence really existed throughout a considerable part of the Tertiary period.

This strange history has been made use of by a talented American writer, Mrs. Charlotte Perkins Gilman, to point a moral against those who oppose the possibility of the social advancement of humanity. It is one of three such illustrations in a poem under the heading of "Similar Cases" in a volume entitled "In This Our World." The name "Eohippus" was given by Professor O. Marsh to one of the less-known remoter ancestors of the horse



THE EVOLUTION OF THE HORSE

The top picture shows Eohippus, which was about the size of a fox and ran on four and three divided toes. The centre picture is Miohippus, which ran on three toes, and the bottom picture shows how all the toes but one have disappeared in the present horse

fact, difficult to tell in which continent the true horses now living actually originated. In both there was an animal about the size of a fox which seems to be the earliest direct ancestor of the modern horses and asses. This intermingling of the ancestral forms of a group so well adapted for migration both in structure and habits renders it certain that such connecting lands and such

"SIMILAR CASES."

There was once a little animal
No bigger than a fox,
And on five toes he scampered
Over Tertiary rocks.
They called him Eohippus,
And they called him very small,
And they thought him of no value—
When they thought of him at all;
For the lumpish Dinoceras
And Coryphodont so slow,
Were the heavy aristocracy
In days of long ago.

Said the little Eohippus:
"I am going to be a horse,
And on my middle finger-nails
To run my earthly course;
I'm going to have a flowing tail,
I'm going to have a mane,
I'm going to stand fourteen hands high
On the psychozoic plain."
The Coryphodont was horrified,
The Dinoceras shocked;
And they chased young Eohippus,
But he skipped away and mocked.

Then they laughed enormous laughter,
And they groaned enormous groans,
And they bade young Eohippus
Go and view his father's bones.
Said they: "You always were as small
And mean as now we see,
And therefore it is evident
That you're always going to be."
"What! Be a great, tall, handsome beast
With hoofs to gallop on?
Why, you'd have to change your nature!"
Said the Loxolophodon.

They considered him disposed of,
And retired with gait serene—
That was the way they argued
In the early Eocene.

ELEPHANTS AND THEIR ANCESTORS. The elephants are of special interest for two reasons. Their distribution in middle and late Tertiary times was very similar to that of the horses, and they disappeared from America, Europe, and Northern Asia at as late or even later a period and with equal suddenness. The huge mammoth with its enormous curved tusks lived in Northern Europe and Asia as well as in North America down to the human period. Many other species are of late Tertiary date and died out a little earlier; and among these were some curious small elephants from three to five feet high, whose remains are found in the caves of Malta and Cyprus. The allied mastodons have a similar distribution at a

somewhat earlier period, and these ranged over both North and South America and survived there till the appearance of man.

None of these numerous forms gives any clue to the early stages of the elephant type so strikingly different from all other mammalia. But within the last ten years remarkable discoveries have been made, in the early Tertiary beds of the Fayum valley in Middle Egypt, of an interesting group of fossils of mammals which are believed to be the ancestral forms of the entire elephant tribe. The earliest of these is an animal not very different from the ancestral swine and tapirs, and of very small size. The whole series is not yet complete, but the following short account, from the "Guide to Fossil Mammals" in the British Museum, very clearly explains its bearing upon the problem.

"The fossils, so far as known, show that the earliest forerunners of the elephants were small marsh-dwellers which lived on a succulent food in the African region. They gradually increased in size without essentially altering their limbs or bodies; but as their legs lengthened and their neck shortened, their face and chin gradually became elongated to reach the ground for browsing. When this strange adaptation had reached its maximum degree, the chin shrivelled, leaving the flexible toothless face without any support. Thus arose the unique proboscis of the elephants, which has become prehensile by stages which cannot be traced, because soft parts are not preserved in ordinary geological formations."

In the "Guide to Recent and Fossil Elephants," 1908, there is a diagram showing the proportionate sizes of the three chief types of fossil elephants previously known, together with the two recent discoveries in Egypt, which is very instructive. In these we see the progressive shortening of the chin, the straightening of the tusks, then their bending downwards instead of upwards, and lastly their reduction to ordinary-looking teeth in both jaws. It is also very suggestive that this change occurred at a period when Africa was cut off from the rest of the world by a sea extending from the Atlantic across Northern India. These early forms were thus subject to special conditions from which they could not escape by migration, and thus gave full play and ample time for the action of variation and natural selection to initiate the main elephantine characteristics.

When, in the middle Tertiary, free land connections were formed to Asia, Europe, and North America, elephants had attained such a size and such completeness of organisation that they were enabled to spread over the two hemispheres, becoming modified in each into special forms adapted to the new conditions.

Then, after a long period of success, a number of competing tribes arose, such as the extensive and varied hoofed ungulates culminating in the cattle, deer, and antelopes, as well as a host of large and powerful carnivores culminating in the great sabre-toothed tiger, when the elephants everywhere became extinct, except in the two most favourable localities for their maintenance—that is to say, in the equatorial forests of Africa and Asia.

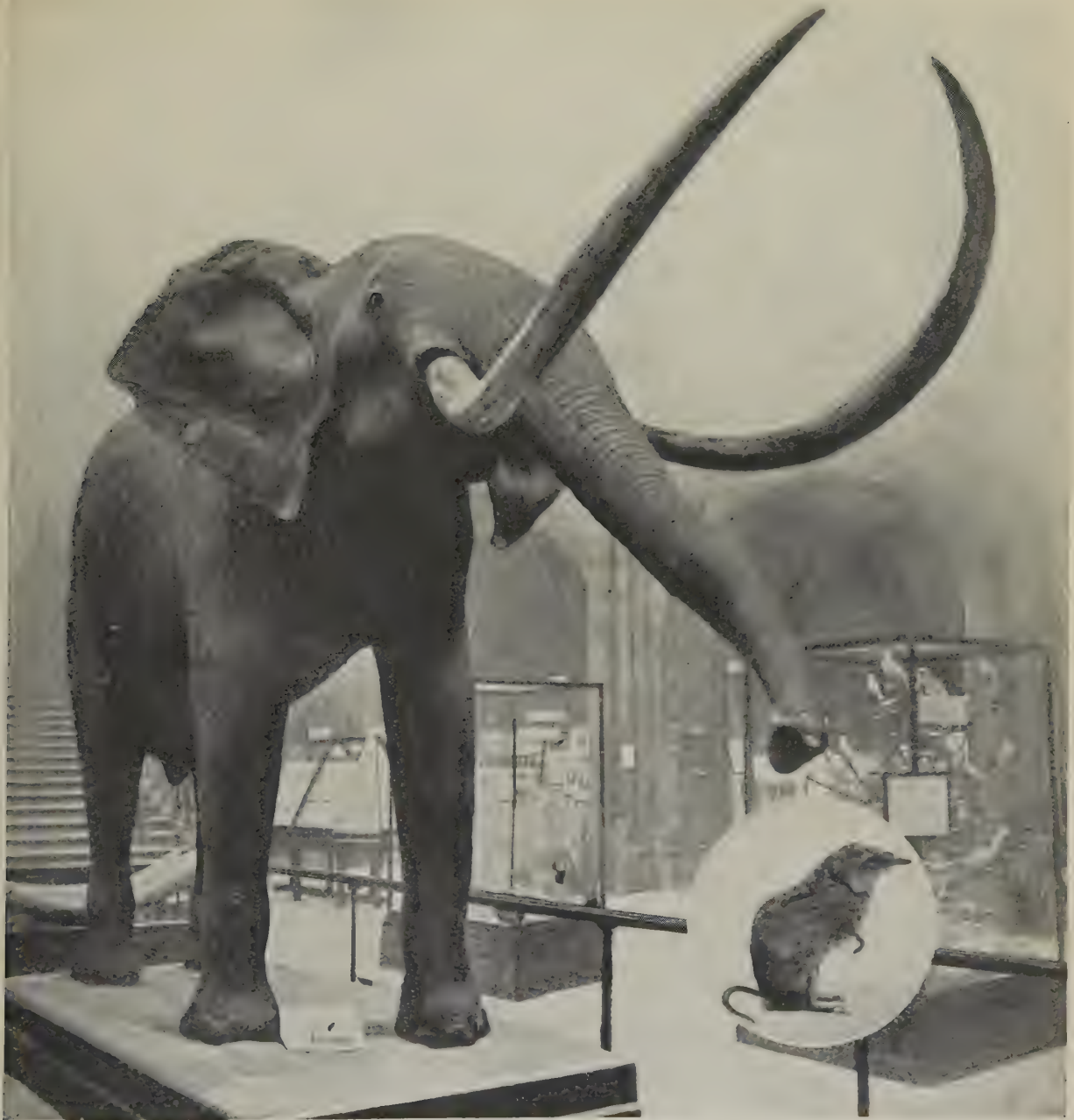
WHY ARE DEER AND BEARS ABSENT FROM TROPICAL AND SOUTH AFRICA? The Tropical African region affords us one of the most interesting problems in zoological geography. In many of its larger mammals and birds it presents a considerable resemblance to those of Tropical Asia, yet there are some most remarkable deficiencies. The most singular is the absence of the whole of the deer and the bear tribes, which are found in all the other continents, together with the camels, goats, and sheep which abound in the adjacent parts of Asia.

Now, the explanation of these peculiarities is to be found, first, in the existing fauna of the great island of Madagascar; and secondly, in that isolation of Tropical and South Africa from the rest of the world during the early portion of the Tertiary period, which is proved by a vast extent of early Tertiary marine strata to the north of it, and which has been already mentioned as having led to the early development of the elephants.

The interest of Madagascar lies in the fact that the evidence all points to its having been formerly united with Africa, but only at a time when that continent possessed a much more restricted fauna than now. For although Madagascar contains about seventy different species of mammals, these are mostly of low type, while none of the larger and more highly developed African groups is found there. Though there are nearly forty of the lower quadrumana (the lemurs), there is not a single monkey or ape. The great carnivora of Africa—the lions and leopards, the hyænas and lynxes—are absent and are represented only by eight civets, all of peculiar genera; the very numerous rodents of Africa, including squirrels, porcupines, and hares, are absent, the order being represented by a few peculiar mice; while the ever-present antelopes of Africa—nearly 100 species—as well as its zebras, rhinoceroses, and elephants, are quite unknown. In place of all these we find only a river-hog, while a small hippopotamus seems to have recently died out, both of which, being semi-aquatic in habits, might, in very favourable circumstances, have crossed the Mozambique Channel. The reptiles show similar singularities, most of the genera being peculiar; while two families of snakes, both abundant in Africa, are wholly wanting. Even the birds exhibit the same phenomena. The genera and some of the families are quite peculiar, but they seem to be related to Indian as much as to African types. A number of specially African birds, such as hornbills, plantain-eaters, and barbets, are absent.

We thus find that all the facts go to prove that the fauna of Africa must have been very poor as regards variety of its higher animals at the time when Madagascar was separated from it; and that epoch is demonstrated to be a rather remote one by the distinctness of the two faunas now, and also by the number of peculiar species and genera of the higher mammalia and birds characterising that continent. We conclude, therefore, that the separation from Africa dates from the early Tertiary period.

For the later history of animal life in Africa we are indebted to the geological record in other continents. We find that all the larger and more



THE LARGEST AND THE SMALLEST MAMMALS IN THE WORLD: AFRICAN ELEPHANT AND PIGMY SHREWMOUSE

Between the elephant's fore feet is a model, in exact proportion, of the pigmy shrewmouse, which is enlarged in the inset

From a photograph by J. L. Clarke of the models in the Natural History Museum, South Kensington

characteristic of the great mammalia of Africa inhabited Southern Europe and Northern India in the middle and late Tertiary periods. Such are the great carnivora—lions, tigers, and hyænas, the extensive and varied hoofed animals, from the zebras, rhinoceroses and swine, to the antelopes, the giraffes, and even the okapi—all of which have left their bones or skeletons in middle or late Tertiary strata.

It becomes clear, therefore, that not long, geologically speaking, after Madagascar was separated from Africa, the Saharan sea was partially elevated so as

to open one or more free passages into the African continent. Then the highly organised mammals just enumerated would migrate into the new and inadequately peopled land, would there increase rapidly, and develop into a variety of distinct species fully adapted to the new conditions.

Then came the third and last great change, the simultaneous subsidence of the Mediterranean area, and the elevation of that of the Sahara and of Arabia, bringing about the desert conditions of these countries, and thus isolating Tropical and South

Africa. Thenceforth the typical African fauna was left to develop uninfluenced by immigrations from the extensive Euro-Asiatic continent, leading to that endless variety and abundance of "great game" in which this region is pre-eminent.

And now, at the end of this strange series of geographical changes and zoological migrations, we find the solution of the problem of those deficiencies which are so remarkable a feature of this continent. For the varied and widespread deer tribe only reached their full development in the later Tertiary period; while the true bears seem to have originated about the same epoch, and to be in fact at their fullest development in our own time. These two groups, therefore, either did not exist in the adjacent regions, or were so comparatively weak in structure as not to be fitted to take part in the great rush of migration to the newly opened land. The absence of camels is probably due to the fact that, as already shown, they originated in North America and entered Asia from the north-east. They had reached North-west India towards the latter part of the Tertiary period, and were too remote from Africa to take part in the great incursion. The goats and sheep seem to be among the very latest developments of the large tribe of Bovidae, or hollow-horned ruminants, and as they are pre-eminently mountain animals, they would not have been in a position to take part in a low-land migration, even had they been in existence at the time, which they probably were not.

As the whole subject is both vast and complex, I will here re-state the fundamental facts and conclusions on which a true explanation of all cases of anomalous distribution must be based.

(1) The most fundamental of all is the proof, by the agreement of several distinct lines of argument, that the great continental and oceanic areas are not interchangeable, but are permanent features of the earth's surface, subject only to marginal extensions and reductions within fairly well-defined limits.

(2) The slow but important changes of climate that appear to have been always going on. The more important of these for our special inquiry is the proof of an almost tropical climate in much of the temperate and sub-Arctic zone in the early Tertiary, changing gradually to warm-temperate towards its close, and then merging into the oncoming Glacial period. This must never be overlooked, as it often is, because, with moderate land extensions in the northern parts of both the Atlantic and Pacific Oceans, it offers ample means of migration, even of warm-country animals, between the several continents, and entirely obviates the supposed necessity for repeated bridging of the tropical and sub-tropical oceans, which has been shown to be unsupported by any evidence, opposed to a large body of facts, and almost, if not quite, physically impossible.

Other factors of secondary importance are: the various powers and facilities of dispersal by the different groups of animals; the evidence of geology as to the preceding forms of life in the same areas and elsewhere; the frequent changes of climate and the nature of the vegetation; lastly, the continuous action of the competition of better-

adapted forms of life, rendering it impossible for newcomers to maintain their existence, even if occasionally introduced into a new country.

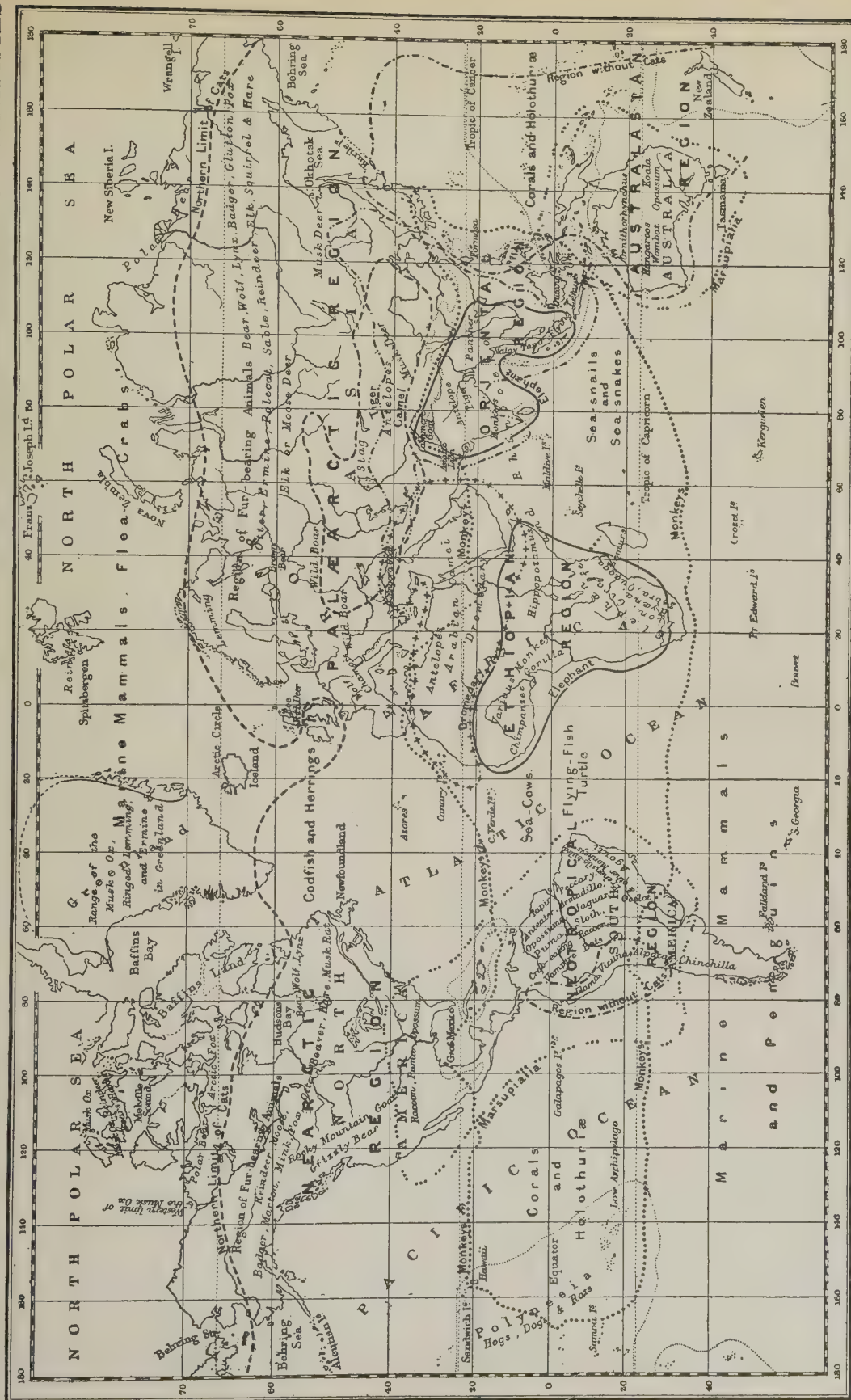
We thus see that the present distribution of the whole vast complex of living organisms is the final outcome of the entire course of evolution from the earliest dawn of life. The locality and range of every animal and plant may therefore be looked upon as one of its vital characters. It is what it is and where it is because it has been developed in close adaptation to the physical and organic environment in which it lives, and where alone, except in very rare cases, it is able to maintain its existence.

The higher and more completely adapted forms—the dominant and aggressive species, as Darwin termed them—will always be able to maintain themselves, sometimes at the expense of native forms, when they gain access to a country previously occupied by lower types, as was the case when the highly developed animals of the Euro-Asiatic continent gained access to Tropical Africa. We see the same thing occur in the case of the European sparrow introduced into North America and the common rabbit into Australia, both of which have become pests in their new homes. But they have in both cases been assisted by man's interference with the native fauna and flora, and it is very doubtful if the same results would have followed any chance introduction of these species into countries where man had not already interfered with the balance of competing life.

THE DIVISION OF THE GLOBE INTO ZOOLOGICAL REGIONS. In order to describe and compare the distribution of the various species, genera, and families of animals, it has been found necessary to mark out a certain number of extensive areas characterised by distinctive forms of animal life. The older naturalists usually adopted the great geographical and racial divisions—Europe, Asia, Africa, America (North and South), and Australia, or the still broader Arctic, Temperate, and Tropical Regions. They also used the general term "India or the Indies" for all Eastern tropical lands, sometimes including all the Tropics, as in our still common but misleading term "West Indies."

The first thoroughly scientific attempt to establish a series of regions that should accurately summarise the main facts for any extensive class of animals was made by Dr. P. L. Sclater in 1857 for the class of birds, at that time, as it is now, probably the best-known of all the more extensive groups of animals. He was the first to point out that Europe and Asia do not correspond to primary divisions of animal life, as shown by the striking similarity and considerable identity of both the birds and mammals across the whole of Europe and temperate Asia. This formed his first great region, which he termed the "Palæarctic," as including all Old World northern lands. Then came the tropical portion of Asia, which possessed hosts of altogether peculiar species, genera, and whole families of birds not known in the temperate zone. This he termed the "Indian Region," because India in a wide sense

MAP OF THE WORLD ILLUSTRATING THE GEOGRAPHICAL DISTRIBUTION OF ANIMALS



This map is based on the distribution scheme proposed by Dr. Philip Lutley Sclater in 1857—originally for the class of birds, but afterwards adapted to the animal kingdom—and, includes the modifications and extensions introduced by Dr. Alfred Russel Wallace. It shows the six great regions into which, for this purpose, the earth has been divided—namely (1) the Palearctic, embracing the Northern Old World and Africa to the Sahara; (2) the Oriental, or India, Burma, Siam, and the Malay Islands; (3) the Australasian, comprising the island continent, New Zealand, and most of the Pacific Islands; (4) the Ethiopian, that is, Central and South Africa; (5) the Neotropical, composed of South America, the West Indies and Central America as far as Mexico; and (6) the Antarctic, including Temperate and Arctic North America

formed the bulk of it. This term in my "Geographical Distribution of Animals" I altered to "Oriental Region"—perhaps unnecessarily—because it included Burma, Siam, and all the great Malay islands, and this name has been widely adopted. It may be mentioned that the Palæarctic Region also included North Africa as far as the Sahara, all its chief productions, both animals and plants, being closely allied to those of Europe or Western Asia. The remainder of Africa, possessing a large proportion of peculiar types, and being thoroughly isolated from the rest of the world, constituted the "Ethiopian Region." The fourth was the "Australian Region," perfectly characterised by its very peculiar marsupial mammals, as well as an immense number of peculiar genera, and of several remarkable families of birds. The eastern half of the Malay Archipelago belongs to it, as do also New Zealand and most of the Pacific islands. Then came South America, including the West Indies and Central America as far as Mexico, forming the "Neotropical Region," because it included the whole tropics of the New World. Temperate and Arctic North America constitute the "Nearctic Region" of Dr. Sclater. It has relations with both the Neotropical and Palæarctic regions, but has sufficient special features to be kept distinct.

It will be seen that the past geographical history of the several regions, as we have been able to trace it both by stratigraphical and palæontological evidence, enables us to understand why each of these regions possesses broad distinctive features while presenting certain resemblances to several others. By laying undue stress on these resemblances the primary zoological regions have been reduced in number and altered in constitution by some writers, so as to render them of little use or interest to the general reader, or even to the general student of zoology. Professor Huxley, for example, proposed a threefold division—Arctogæa, including the whole Northern hemisphere, with Africa and Malaysia; Notogæa, for South America and Australia; while New Zealand formed a region by itself. This division was founded on the prevalence of a low type of birds and of mammals in Notogæa, and on the lowest existing reptile—the curious lizard-like *hatteria*, found only in New Zealand, and there almost extinct. But these all depend on features of anatomical structure only appreciated by specialists, while a single region—including Europe, Asia, Africa, and North America—is absolutely useless for any practical purpose. Mr. Andrew Murray united India and Africa as one region, and North and South America as another; while several modern writers insist that North America is too much like Europe and North Asia to be separated from them, and thus form what they term the "Holarctic Region."

As this last is rather widely adopted owing to its having been advocated and taught at Cambridge for many years by Professor Alfred Newton, especially as regards the class of birds, I will give a few of the main facts which show how great and fundamental are the differences of the two regions.

No fewer than twelve out of the thirty-six families

of land birds inhabiting the Palæarctic region are not found in the Nearctic; which latter has eight families not in the Palæarctic. Of genera, there are 118 which are Palæarctic but not Nearctic, and 113 Nearctic but not Palæarctic. Stating some of these facts in popular language, we find in North America three very common families of birds—the wood warblers (*Mniotiltidæ*), the hang-nests (*Icteridæ*), and the tyrant birds (*Tyrannidæ*)—containing together nearly 100 species spread over the whole country, all three of which families are totally unknown out of the American continent. In Europe and North Asia we have the hedge warblers (*Accentoridæ*), the fly-catchers (*Muscicapidæ*), and the starlings (*Sturnidæ*), quite unknown in America; besides more than twenty genera with over 100 species of warblers and their allies, as well as twelve genera with fifty species of pheasants and their allies, all equally unknown in America. Summarising the whole, we see that, in either region, the genera of birds which it has in common with the other do not amount to one-third of the whole number it possesses; while the species common to both, mostly Arctic, only amount to twenty. So far as the mammalia are concerned, there is a rather larger amount of resemblance, but even in their case the diversity is still ample.

But, further, when we consider the very important part North America has taken in the development of the higher animals, especially of the great tribe of ruminant mammalia, including such specialised types as the camels and the horses, which seem to have been peculiarly its own, any division of the earth into zoological regions which obscures or ignores this past history by uniting this vast country either with Eurasia or with South America to form a single region must be equally inadmissible. The same objection applies to uniting Africa with India. Each has its peculiar families, and a very large number of peculiar genera of all the higher animals; but, because these are often small and not generally known, the groups of larger and more conspicuous mammals and birds which are common to both are allowed to obscure the more fundamental diversities. Even if we do, against the weight of evidence, make any such compound regions, we must immediately separate them again as "sub-regions," or we lose all the advantage of easy and intelligible classification of the many peculiarities of the Ethiopian fauna in all its groups from mammals to insects.

It is for these reasons, which I have given in full detail in my works on the subject, that I still thoroughly hold the scheme of six primary zoological regions proposed by Dr. Sclater to be in all respects more accordant with the great facts of the existing distribution of animals as well as with their geological history, and the past geographical changes of the earth, than any which has since been proposed. As the most accurate and most useful classification for the student, as well as the most intelligible and most illuminating for the general reader, it holds the field against all attempts hitherto made to improve it.

ALFRED RUSSEL WALLACE

ANIMAL LIFE IN THE BRITISH EMPIRE

A UNIQUE ASSEMBLAGE OF THE WORLD'S FAUNA

By Sir HARRY JOHNSTON

THERE are two reasons why it is important to try to realise the more interesting features of the fauna characteristic of the many countries in every clime which Fate has placed under the British flag. The first reason is the scientific, commercial, and æsthetic value of this unrivalled assemblage, such as no other nationality controls, of beasts, birds, reptiles, fishes, insects, spiders, crustaceans, molluscs, worms, echinoderms, corals, and sponges found within the limits of the British Empire. And the second reason is the necessity, for the prevention of disease, that old and young, poor and rich, black man and white man, should learn the main facts about harmful insects, life-draining intestinal worms, and, most of all, in regard to those infinitely minute yet infinitely powerful protozoa which lie at the base of the Tree of Life, but which in some parasitic forms can be far more dangerous to the bodies of man and other mammals than tiger, cobra, viper, or shark.

Since, however, it would be impossible in some cases, and difficult in others, to marshal for review forms that are either microscopic or externally small and insignificant, the protozoa, worms, echinoderms, molluscs, insects, and crustaceans are better left to be considered in detail in the section of this work devoted to the non-vertebrate forms of life. When we talk of the "fauna of the British Empire," it is usually only the animals which "catch the eye" that people think of, and these will be the theme of the following "abstract and brief chronicle."

The most ancient of the backboneed creatures are the fishes, and among these the sharks count for much in popular imagination. Perhaps the most remarkable form of this subclass of cartilaginous-skeletoned fishes is the Port Jackson shark, found on the south-east coast of Australia, not dangerous to man, but of extraordinary appearance, with a weird resemblance to a human being in its eyes and nose. The sharks which follow ships and

haunt harbours and surf-bound coasts in the Tropics for the chance of devouring human beings falling into the water belong to the genus *Carcharias*. The "hammer-head" sharks are occasionally captured off the east and south-west coasts of Great Britain. Basking sharks, which reach to a length sometimes of 40 ft., have been caught on the coasts of the United Kingdom. The strange saw-fishes, distant relations of the sharks, are found in the estuaries of East and West African rivers belonging to Great Britain. An awful-looking creature, justly dreaded by the negro fishermen of the West Indies and Central America, is the eagle ray. This enormous skate has developed its pectoral fins into immense wing-like surfaces measuring 20 ft. to 30 ft. across the body. The eagle ray is said to pursue the pearl-divers of the Cayman Islands and the Bahamas, to envelop them under water with its bat-like fins, and then devour them; but it is a little difficult to understand how this

last act can take place, as the ray's teeth are flat, and adapted only to crushing shellfish.

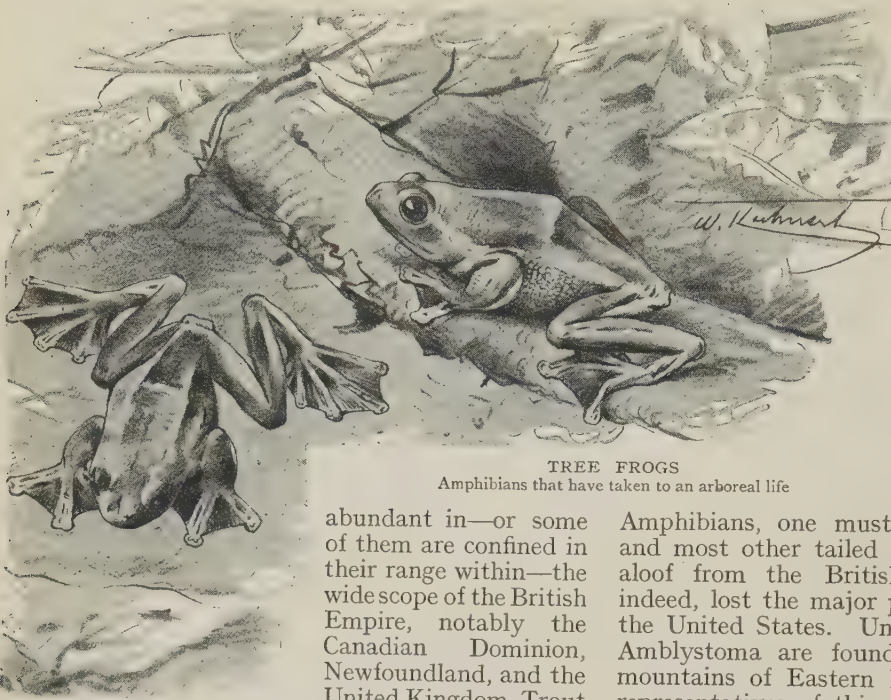
The common sturgeon frequents the British coasts and is occasionally found in the Severn and the Trent, and used to be obtained in the Thames. Ever since an Act of Edward II. it has been a Royal fish, the property of the British Sovereign, wherever it be caught within the limits of his kingdom.

Many of the useful fishes of the world are distinctly "British," such as the trout and the sea trout, the salmon, the charr, the grayling, the smelt, and the white-fish, of which there are three peculiar British species—the gwyniad, the vendace, and the pollan—Celtic fish, as they might be called, since they are

almost confined in their distribution to the still Celtic portions of Great Britain and Ireland. Though most of these generic types of the beautiful and comestible salmon family are found in many parts of Europe, Northern Asia, and North America which are not British yet they are particularly



THE CURIOUS SEA HORSES OF THE BRITISH SHORES
This fish swims with its body in a vertical position



TREE FROGS
Amphibians that have taken to an arboreal life

Central Africa from the Zambezi northwards, Victoria Nyanza and the Upper Nile, the Shari, Lake Chad, and British Nigeria, Sierra Leone, the Gambia, and French West Africa. The third genus, *Lepidosiren*, is not only solely South American in its range, but apparently is confined to the basin of the Amazon and the northern part of Paraguay. Unless, therefore, it is some day discovered in the rivers of British Guiana, it cannot be called a British citizen.

Passing now to the

abundant in—or some of them are confined in their range within—the wide scope of the British Empire, notably the Canadian Dominion, Newfoundland, and the United Kingdom. Trout have also been intro-

duced into New Zealand and British Central Africa, and have become naturalised there. The place of the salmon as a “sporting” fish is taken in India by the mahsir of the Indian rivers and mountain streams, a gigantic barbel or carp, sometimes 5 ft. in length. Then there are the eels of the British rivers and coasts, the rivers and coasts of Newfoundland, and the West Indies, the pike of the United Kingdom and of Canada, the extraordinary “sea horses” of the British shores, the climbing perch of Ceylon, India, and Malaysia, the cod of the Newfoundland Banks—one of the several fishes or marine forms that have been the cause of national quarrels and the extension of empires. The beautiful sea breams of the West African and Australian coasts frequently assume the most gorgeous colouring of crimson-scarlet or red-gold. The British coasts are well supplied with the invaluable flat fishes—soles, flounders, halibut, dabs, turbot, and brills.

Before leaving the fishes, mention should be made of the lung-fishes, because they descend from an immeasurable age in time, their earliest representatives going back far into the Primary epoch. They attracted great interest when first revealed to science in their living forms in consequence of their breathing air through lungs, but they are now thought to be not so closely connected with the ancestral line of the amphibians as the ganoids. They are noteworthy because of their present curious distribution. One genus, *Ceratodus*, is *entirely* confined to the fresh waters of Australia. The second genus, *Protopterus*, is restricted to the lakes and rivers of Tropical Africa—the Congo basin, British

Amphibians, one must confess that salamanders and most other tailed amphibians keep singularly aloof from the British Empire. Great Britain, indeed, lost the major part of them when she lost the United States. Unless one or more species of *Amblystoma* are found in the Himalaya or the mountains of Eastern Burma, she is without any representatives of this order, with the exception of three species of newt in the British Islands. As to the tailless amphibia (frogs and toads), on the other hand, the British Empire has much to boast of. There is the remarkable tongueless Surinam toad, chiefly confined in its distribution to Guiana, which develops cavities in the back of the female into which the eggs are pressed by the male, here to develop into tadpoles. The true toads are found all over the world, except in New Zealand, New Guinea, and Madagascar; but the Australian toads are of three genera peculiar to that island-continent. The true tree frogs avoid British dominions somewhat, though they are found in Australia, in Assam, and in portions of Canada. It is curious that they should not have reached England, since they are found all over France and even penetrate to Belgium and Holland. There is a giant tree frog in the forests of British Guiana nearly

THE TUATERA, OR SPHENODON LIZARD OF NEW ZEALAND
The oldest reptile in the world, which may be described as a “living fossil”



THE TUATERA, OR SPHENODON LIZARD OF NEW ZEALAND
The oldest reptile in the world, which may be described as a “living fossil”

ANIMAL LIFE IN THE BRITISH EMPIRE

5 in. long, reddish brown with a black stripe along the spine, and with very large adhesive discs to its fingers and toes.

Britain occupies a proud position in regard to the Reptiles, for she alone possesses the oldest reptile in the world, the Tuatera, or *Sphenodon* lizard of New Zealand, not properly a lizard, but a representative of a very ancient and generalised order, the Prosauria, from which all the other reptiles, the mammalia, and even the birds may have ascended. Ancestors or collateral relations of the tuatera once lived in Warwickshire, Shropshire, and Eastern Scotland, and no doubt other parts of Britain and Ireland, as well as Europe, India, etc, in the Triassic period of the Secondary epoch.

It is one of the many surprises in biology that the only survivor of this early, generalised order of true

New Zealand was colonised before her people felt much interest in natural science. Otherwise, New Zealand would have chosen for its national emblem not—whatever it may be—the Southern Cross, or other hackneyed symbol, but the Tuatera lizard; for, however poor in fauna, New Zealand should be the proudest country in the world as the possessor of a living *sphenodon*.

With regard to Tortoises and Turtles, the Empire possesses the gigantic land tortoises of the Aldabra, Chagos, and Seychelles archipelagoes of tiny islands in the western Indian Ocean. They were formerly inhabitants of the Amirante Islands, Rodriguez, Bourbon, and Mauritius, as well as of Madagascar and the Comoro Islands, but except in North and South Aldabra, the Chagos, and Seychelles, they are everywhere extinct, having been



CROCODILES AND WATER BIRDS ON LAKE NYASA

From a painting by Sir Harry Johnston

reptiles should live in the very antipodes of its original habitat. The tuatera, as a genus, is without doubt the most ancient survival amongst air-breathing vertebrates. Its existence, more or less in its present form, may go back to a period distant from our time by ten millions of years. During this vast period this order of reptiles became extinct everywhere but in New Zealand, and even here they were nearly wiped out before their importance was fully realised. Bush fires, the multiplication of dogs and cats, and the hatred of "vermin" on the part of the British colonists are the causes which have reduced the existing tuateras to a few hundred specimens on the islets in the Bay of Plenty. Unfortunately,

found to be good for food. Perhaps there would not be a single living gigantic tortoise under the British flag but for the interposition of Mr. Walter Rothschild, who saved the great tortoises of the Aldabras by leasing the northern island from the British Government.

The green or edible turtle, the foundation of turtle soup, is an inhabitant of all the three great oceans within the tropics, but it has to resort to land for breeding purposes, and its most famous places of frequentation are the island of Ascension in the eastern Equatorial Atlantic, the Cayman Islands in the Caribbean Sea, and the coasts of Nicaragua and Honduras. The two first-named are British possessions, and turtle-catching is a very important

industry at Ascension and in the British West Indies. Turtles are also captured for commerce off the coasts of British New Guinea, Borneo, and Ceylon; not only the edible form, but the still more important turtle, the hawksbill, which produces "tortoiseshell." The tortoiseshell of commerce from the hawksbill turtle is also exported from the West Indies.

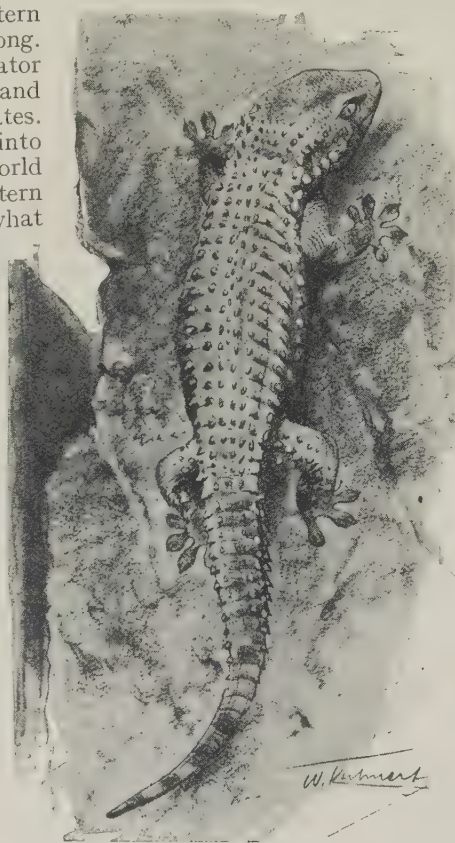
Among the Crocodiles the British Empire possesses examples of every genus except the alligator. Owing to the attention which was given to the alligator by the Spanish discoverers of Florida and Texas, and still more by the British settlers in what is now the United States, this reptile has received a prominence of name and notice wholly disproportionate to its limited geographical distribution. It is still difficult to restrain British sportsmen, settlers, and even officials in Africa or the West Indies from writing about "alligators." There is no alligator in any West Indian island, there are only crocodiles in the West Indies; there is no alligator in India or Burma, but there is a true alligator in the rivers of Eastern China, though not in Hong Kong. The range of the true alligator is limited to the eastern and southern parts of the United States. It scarcely penetrates even into Mexico. Elsewhere in the world it is only found in the eastern part of China. It is somewhat nearly allied to another genus of crocodiles, the caiman. This is a far more remarkable creature than the alligator, grows to a much greater size, and is very ferocious.

Of crocodiles, the large, common, and fierce crocodile of all Tropical Africa extending from the watershed of the Zambezi on the south to Egypt on the north, and the Senegal river on the west, as well as to Madagascar, is *Crocodilus niloticus*. This, and the great marsh crocodile of India, Ceylon, Burma, and Malaysia, the still larger *Crocodilus porosus* of Eastern India, Ceylon, and thence across Malaysia to Southern China, Northern Australia, the Solomon Islands and Fiji, are, with the caimans of South America, the only members of this order of reptiles that are really dangerous to man or to large animals. But the most remarkable living representatives of this order are the gavials, or gharials, of India, Borneo, and the Malay peninsula. These are far removed from the true crocodiles, though belonging to the same order. They belong to a family that was once of world-wide distribution, having in the Secondaries and early Tertiaries lived in Europe and

North America. One genus (*Rhamphosuchus*) of this family, which inhabited India almost down to the Age of Man, reached a length of fifty feet!

Among the great group of Lizards and Snakes common to the British Empire are the geckoes, or house-haunting lizards, with adhesive feet, of Malta, and of East, West, and South Africa, Southern Asia, Australia, and New Zealand, British Guiana, Honduras, and the West Indies. In West Africa there are gaudy red and blue agama lizards that are noteworthy features in all the native towns, where, owing to their pursuit of flies and other insects, they are unmolested. Among other remarkable agamas under the British flag is the flying dragon of Southern India, the Malay peninsula, and Borneo, which has an extensive ribbed membrane that enables it to take parachute flights. In Ceylon there is an extraordinary agama which imitates chameleons in the most misleading way, so that anyone not learned in biology would mistake it at once for a chameleon, a reptile of quite a different suborder.

The extraordinary iguana lizards, many of which develop fantastic shapes and ornaments like the heraldic basilisk, are citizens of the British Empire, but have a very remarkable and puzzling geographical distribution. They are found in Madagascar, but nowhere in Africa. They are found throughout the West Indies and Tropical America, and also in the Fiji Islands of the Pacific. In the West Indies they are noteworthy for possessing delicious flesh, and are much sought after by the negroes as an article of food. In fact, runaway negroes in the old slavery days largely sustained themselves on iguanas. These lizards sometimes grow to a considerable size, and can bite fiercely and lash with their tails. They are almost exclusively tree-haunting—though there are one marine and one ground genus—but take readily to the water when pursued. For the purposes of self-protection they frequent boughs and trunks of trees that overhang rivers, and on the approach of danger fling themselves into the water. They are thus a source not only of embarrassment, but even of harm to travellers passing in canoes or boats, for if a huge iguana lizard



THE GECKO, OR HOUSE-HAUNTING LIZARD
A reptile that can run along a ceiling, back downwards

flops on to you from a height of twenty or thirty feet, weighing perhaps fifty to seventy pounds, it might break your neck.

The monitors, if not the iguanas, are the biggest members of the lizard order, attaining the size of small crocodiles. They are found in India and Malaysia, and in all parts of Tropical Africa right

ANIMAL LIFE IN THE BRITISH EMPIRE

down to Natal, and are persistently misnamed "iguanas" by unlearned Britons in Africa and India. They are celebrated for their long, whip-like tail, with which at close quarters terrible injuries can be inflicted, as well as for their sharp teeth, and their ravages on the poultry-yard, since they are fond of both eggs and fowls.

As regards the great non-poisonous boas and pythons, which kill their prey by crushing, the python genus, members of which possibly grow to 30 ft. in length, if not more, is found in British Africa, India, Malaysia, Ceylon, and Australia. Needless to say, with the prevailing passion for misnaming everything, pythons are usually called "boa-constrictors" in the British dominions. The true boa-constrictor inhabits British Guiana and the rest of Tropical South America, but the largest specimen known only reaches 11 ft., and most of the stories told of its capacity for swallowing large animals really apply to the anaconda, of quite a different genus. This huge snake, which is also found in British Guiana and elsewhere in Tropical South America, inhabits the water chiefly, and undoubtedly attains an enormous size, perhaps as much as 33 ft. in length. The anaconda, like the python, is no doubt able to swallow animals as large as a small deer, and may thus have killed and eaten human beings, though there is no definite record of such a calamity having taken place. The tendency of the python in Africa seems rather to be to "chum" with humanity, and the pythons in the vicinity of native habitations become half tame, and are tolerated for their rat-killing propensities.

With regard to poisonous snakes, these arise from two stems, the colubrine and the viperine, and the last-mentioned divides into two distinct branches, the vipers and the "rattlesnakes." The poisonous colubrines belong to the elapine or cobra group, which is widely distributed over Tropical Africa, Asia, Malaysia, and Australia, with one genus (*Elaps*) in South America and the Lesser Antilles. The British Empire is the unwilling host of many deadly elapine snakes on its land surface, without counting the poisonous sea snakes which frequent the coasts, breeding among the rocks, of the Indian Ocean from the Cape of Good Hope to the Persian Gulf, India, Ceylon, Malaysia, Hong Kong, Australia, New Zealand, and the Pacific coast of Central America.

In South Africa there is an allied genus of coral snakes (*Homorelaps*) to that of South America. There is also the genus *Naja* of true cobras in all Tropical Africa, with at least two species,

and there are several species of tree cobras (*Dendraspis*) and the South African "ringhals," or African hooded cobra (*Sepedon*). In India and Malaysia the poisonous elapine snakes are the common cobra, the giant cobra, or hamadryad, the justly dreaded not very large kraits, the resplendent cobras, and the long-glanded cobras.

The true vipers abound chiefly in Africa. Egypt and British Arabia possess the horned vipers and the saw vipers. In British Tropical and South Africa there are the prehensile-tailed tree vipers (*Atheris*), the egg-laying vipers—the others are viviparous—of the genus *Atractaspis*, the wide-spread *Causus* vipers, and the sluggish, short-tailed puff adders.

There are no vipers in America, but their place is amply taken by the rattlesnakes. Yet the rattlesnakes, though so abundant in North America, seem to have originated in Asia. The one genus of aquatic pitted-faced vipers ranges with several species from the shores of the Caspian Sea to the Eastern United States, and is represented in the fauna of India, Ceylon, and Malaysia. The exceedingly venomous genus *Lachesis* extends its range with numerous species from Eastern India and Ceylon across Malaysia and Southern China, including Hong Kong, to Mexico, Central and South



THE BLACK IGUANA
A lizard of fantastic aspect that haunts trees

America, and to the Lesser Antilles. Especially noteworthy is the fer-de-lance, found in Guadeloupe, Martinique, St. Lucia, and Trinidad, which, together with the coral snake, is the only example of a venomous snake in the West Indies, and that merely in the Lesser Antilles. There are no poisonous snakes in the rest of the West Indian Islands, large or small. In British Guiana and Trinidad there is the terrible "bushmaster," which strikes, unprovoked, at any passer-by who disturbs its slumbers. Its bite is rapidly and certainly fatal.

The British Empire might well be proud of its range of bird life, were the nation not far more eager to destroy than to preserve. There is the ostrich in the Egyptian Sudan, East Africa, and Northern Nigeria, also in South Africa. Curiously enough, this bird is absent from all intervening British Central Africa and Congoland.

In New Guinea and North-Eastern Australia there are four species of cassowary, and the continent of Australia is the sole habitat of the emeu, which in earlier times also inhabited Tasmania and the larger islands of Bass Strait, besides the large Kangaroo Island off South Australia. In fact, the special form of Kangaroo Island emeu

only became extinct in the nineteenth century. In New Zealand there are still living six species of the "wingless" apteryx; and in these two large islands, which are without any indigenous mammals but a rat and some bats, there existed down to the eighteenth century a few gigantic Moas. This was the name given by the Maori people to an order of Ratite birds whose non-flying representatives ranged in size from a monster half as big and tall again as an ostrich to a bird no larger than a turkey.

The hoatzin of British Guiana, almost restricted to the Guianas in its range, is a remarkable bird, for it seems to unite in itself structural affinities with the cuckoos and plantain-eaters, on the one hand, and with the rails and game birds, on the other. Had the colony owned any imagination when it was founded, it would have chosen either this or the Victoria regia water-lily for its emblem.

Nearly all the genera and species of the penguins are represented on the coasts or islands of the British possessions in the South Atlantic and South Pacific—the Falkland Islands, which are

satin-white, black-beaked jabiru stork; in Africa and India the huge marabou stork. In Africa there is the exceedingly handsome saddle-billed stork, whose colouring is glossy black, iridescent green, and snow-white, with a crimson-scarlet beak. The common white stork of Europe used to be a frequent visitor to England until the gunners drove it away. The same agency has extinguished the booming bittern, with its plumage of orange-brown and black, of the East Anglian marshes. The sacred ibis is still found over much of British Africa, as also are two species of flamingo. The rosy flamingo, with its plumage of light vermilion, crimson, and black, is one of the sights of the Bahama Islands in the British West Indies, which it frequents in enormous numbers (see page 55). The horned screamer, a bird in outward semblance and internally like a cross between a goose and a pheasant, comes from British Guiana and other parts of South America. Among notable "British" Anatidæ there are the musk duck of Tasmania and Australia, the eider duck of Northern Britain and Canada,

the steamer duck of the Falkland Islands, the spur-winged goose of Africa, the Cereopsis goose of Australia, the black-necked swan and Coscoroba swan of the Falkland Islands, and the celebrated black swan of Australia.

Among "British" birds of prey there are the Turkey buzzards of British Honduras, Jamaica, the West Indian Islands, and Guiana. British Africa in the south and east, in the Sudan, and on

the Gambia, can boast of the secretary bird. Amongst extraordinary vultures must be mentioned more especially the king vulture of Eastern India. We must not forget the splendid golden eagle of Scotland and Ireland, and the tiny Microhierax falcon of the Malay Peninsula, scarcely larger than a finch. Among the gallinaceous birds are the brush turkeys and mound-builders of Australia and New Guinea, and the handsome curassows and penelopines of British Guiana, Honduras, Trinidad, Tobago, and the Windward Islands. In Africa, among other noteworthy forms is the vulturine guinea-fowl, with a display of pure ultramarine in much of its plumage. The range of this creature is almost confined to British East Africa and Somaliland. In Asia there are the two species of peacock, mainly British in their range—the peacock pheasants, the argus pheasant (entirely British), and a magnificent array of gorgeously-coloured pheasants and pheasant-like birds in the Himalaya, Northern Burma, and the Shan States. The pheasant of the United Kingdom was probably introduced into England by the



THE DEADLY RATTLESNAKE OF BRITISH NORTH AMERICA
The "pit vipers" with the rattle are confined to America

almost entitled to be called "Penguin Land," South Georgia, Tristan d'Acunha, Gough Island, Cape Colony, West and South Australia, Tasmania, New Zealand, and British Antarctica.

Among the grebes and divers should be named the picturesque great-crested grebe, which nests in England, the handsome great northern diver, and, of the petrel order, the wandering albatross of the seas around the Cape, with kindred species along the coasts of Tasmania, Australia, New Zealand, and the Falklands. There was actually an albatross frequenting the eastern shores of Britain, say, a million years ago.

Within the British Empire are most of the known species of pelican, gannet—such a striking feature of Scottish cliffs and islets,—tropic bird, frigate bird, and cormorant. Handsomely-coloured species of the last, with green-black and white plumage, scarlet legs, crimson and blue-skinned cheeks, are found within the New Zealand Dominion.

In Africa is the magnificent goliath heron; in British Guiana are found the scarlet ibis and the large

Romans, though it is not absolutely certain that it may not have lingered from prehistoric times; for fossil pheasants are found in France, and true wild pheasants exist in Eastern Europe.

Cranes and bustards, plovers and jaçanas, though world-wide in their range (mostly), are best represented within the limits of the British Empire. The great auk was a British citizen until it was exterminated. As to pigeons, the eccentric dodo was a native of Mauritius, but was killed out before the British took possession of that island. Besides the magnificent crowned pigeons and the gorgeous fruit pigeons, is a very lovely pigeon, fast nearing extinction owing to merciless persecution by plumage-hunters—the "Mountain Witch" of Jamaica. An extraordinary pigeon of Mauritius—soon done to death, of course, because of its plumage—used to be called the "Dutch Ensign," because its plumage was red, white, and blue—the colours of the Dutch flag before the French adopted the tricolour.

Among the cuckoos, besides the well-known harbinger of spring in England, are the remarkable large ground cuckoo of Borneo and the grotesque black ani of the British West Indies. As to turacos, or plantain-eaters, Britain owns the greater number of the species in British Africa, some of them quite peculiar to British regions. Among these is a very handsome plantain-eater discovered by myself in



THE SACRED IBIS OF NORTH AFRICA

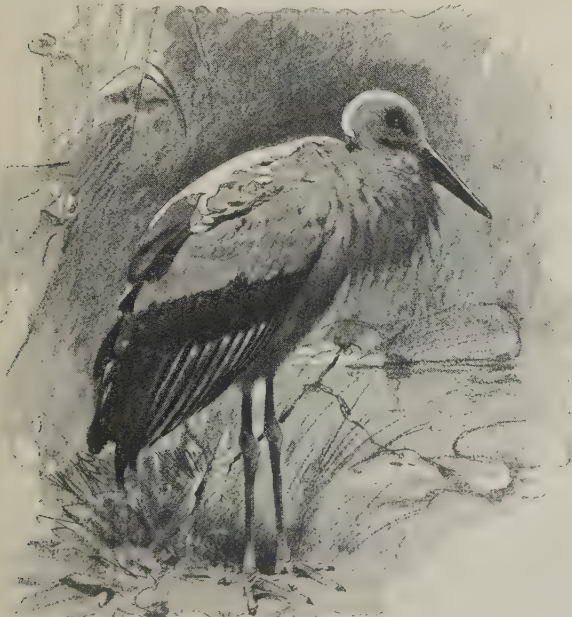
The moon god Thoth of the ancient Egyptians, whose temples it frequented

the westernmost parts of British Uganda, with a large beak exactly the colours of mother-of-pearl, and plumage in which ultramarine blue, emerald green, purple, and rose-colour mingle.

What may not be said about British parrots! The good old grey parrot of Uganda, Southern Nigeria, and the Gold Coast! In true West Africa the light grey parrot with the red tail, which becomes the best talker of all his order, is replaced by a much uglier bird with a purplish-brown tail and grey-brown plumage. British Guiana has splendid macaws, the blue-and-yellow species presenting one of the finest examples of brilliantly contrasted colouring in Tropical South America (see page 53). Several of the smaller British West Indian Islands have parrots of great beauty quite peculiar to themselves. But parrots are the special glory of Australia. Australia's emblem should be the cockatoo. And in this island-continent there are parakeets of unbelievable loveliness and delicacy of plumage. They are not radiant in scarlet, crimson, orange, emerald, blue, and purple, but adopt the exquisite pale tints of æsthetic muslins—pale pink, pale lemon, dove-grey, pale azure, rose, lavender, sea-green, and so forth.

With regard to kingfisher-like birds, I must not fail to enumerate the tody of Jamaica—an exquisite mite, with a long, flat yellow beak, a crimson-scarlet gorget, a white stomach, and an emerald-green body. There is the beautiful little kingfisher of the British Isles, against which a dead set is made by country boys and men because its feathers are useful for making artificial flies. Nor should one overlook the laughing jackass kingfisher of Australia, or the long-tailed kingfishers of New Guinea.

Some of the most extravagant of the horn-bills come from India and Malaysia, as well as



THE WHITE STORK

These birds were formerly summer residents in England

West Africa. The great snowy owl is found in Canada, and many species of the eagle owl in parts of the Old and New Worlds under British control. Humming-birds are met with in Southern Canada—especially in British Columbia—and also as far north as Newfoundland, but only during the summer months. There are special and beautiful species in most of the British West Indian Islands and British Guiana. In this last colony toucans are found, and an allied group of birds, the barbets, is well represented in British Africa, one of them, the crimson-breasted barbet, being of gorgeous colouring, and having a large toucan-like bill.

It is impossible to catalogue the passerine birds of the British Empire. This immense order includes thrushes, nightingales, robins, and other warblers, finches, larks, wagtails, titmice, shrikes, starlings, crows, ravens, jays, and paradise birds. These last are peculiar in their distribution to New Guinea and the adjacent islands, and consequently the most beautiful and most wonderful among them are British subjects. So also are the allied bower birds of Australia, the colour arrangements of which are amazing in their subtlety, just as their habits of making ornamental walks or bowers, or museums of shells and seeds, are almost human. One of the most remarkable genera of the passerines is also, perhaps, the largest in size—that of the lyre birds of Eastern Australia. This type is, in a small way, one of the world's wonders, and it is a shame that the three species of this bird, peculiar to the eastern half of Australia, receive no stringent protection from the great Commonwealth.

As to the Beasts of the British Empire, its wealth in this respect is enough to invite an attack from a jealous coalition of other Powers not so favoured. It owns exclusively the most primitive of the egg-laying mammals—the duckbill—in Australia and Tasmania (see page 54). The ordinary five-toed echidna, in several varieties or subspecies, inhabits Tasmania (where it is largest), Australia, and British New Guinea. The Empire possesses nearly all the marsupials of the world in Australia and New Guinea, and some of the American opossums in British Guiana and British Honduras. In certain respects the most remarkable marsupial is the Tasmanian devil—a large, clumsy, and exceedingly fierce dasyure peculiar to that Garden Island of English loveliness.

As regards the edentates, the Empire has all the three ant-eaters in British Guiana, one sloth, and two kinds of armadillos—the giant and the broad-banded. In British India, Ceylon, and Malaysia there are two species of scaly pangolin, or manis, and in Africa four species of this enigmatic animal, which is only called an edentate because it has no teeth, and not because it has any affinities with the American sloths and armadillos. In British Africa also, more than in other states of that continent, there is the equally mysterious, unrelated aardvark, which likewise lives on ants and termites. Another "British" mammal of great antiquity in type and geological age is the hyrax, or rock-rabbit—the coney of the Bible—which in several species is found in British Africa from Egypt to Cape Colony, and the Gambia to Somaliland.



A COLONY OF AMERICAN FLAMINGOES NESTING IN THE BAHAMA ISLANDS, OFF THE COAST OF FLORIDA
From a reconstructed group in the Natural History Museum, New York

ANIMAL LIFE IN THE BRITISH EMPIRE

As regards the elephants, the Empire almost monopolises the living Asiatic species, which only exists in a wild state now in Ceylon, Eastern and Southern India, Burma, the Malay Peninsula, Northern Siam, and perhaps Sumatra. The African elephant occurs in British East Africa and Uganda, British Somaliland, Northern Nigeria and Eastern Sierra Leone, British Central Africa and Northern Zambezia.

In British East Africa, and perhaps in British Somaliland, there is Grévy's zebra, the most splendid of all the zebras, besides other handsome varieties. Though there is no wild horse under the British flag, there is the parent of the domestic donkey in the Nubian wild ass of the northern and eastern parts of the Egyptian Sudan.

The Empire has a veritable "corner" in rhinoceroses, as it possesses the remaining specimens of the one-horned or Indian rhinoceros, which continues to exist on the south-eastern slopes of the Himalaya and in Northern Assam. In Eastern Bengal, Assam, Lower Burma, the Malay Peninsula, Borneo, and Java, it is succeeded by the smaller-sized one-horned rhinoceros. The two-horned Asiatic rhinoceros ranges from Bhutan and Assam down the Malay Peninsula to Sumatra and to Borneo, but not to Java. In Africa there are still living a few white rhinoceroses with the square, unprehensile lip, in Zululand—perhaps literally two or three,—in the northern part of Mashonaland, and in the northernmost parts of the Uganda Protectorate; and possibly, in addition, a few may yet be found in the southern regions of the Egyptian Sudan. The common two-horned African rhinoceros with the prehensile lip occurs sparsely in British South Africa and the eastern parts of British Central Africa. It is fairly abundant in British East Africa and in the northern parts of the Uganda Protectorate. It is also said to exist in the western parts of the Egyptian Sudan, in the countries round Lake Chad, and perhaps elsewhere in Northern Nigeria.

The large hippopotamus, which was once an inhabitant of Britain, and perhaps also of India, is now very rare in the Lower Nile; has been, indeed, exterminated north of Khartum. But it is very abundant in the Upper Nile and its tributaries, and throughout British East Africa, British Central Africa, the Zambezi and all its affluents, the Niger and Benue rivers, Lake Chad and the Gambia river, together with, perhaps, the western rivers of Sierra Leone. In the extreme east of the Sierra Leone

Protectorate the vast creature is replaced by the pigmy hippopotamus of Liberia.

As to the wild swine, the wild boar has long been extinct in Britain, but one, at least, of the domestic breeds of pig in Ireland seems to be descended from a wild species. Nevertheless, by far the greater number of modern British pigs are descended really from the Asiatic wild boar.

The handsome red river hog of British West Africa and Nigeria extends its range eastwards till it enters the Uganda Protectorate. In British East Africa and British Central Africa are at least two other species of bush pigs, with bony excrescences above the tusks, and a fourth is found in the eastern parts of British South Africa. Again—only recently discovered—in the few patches of dense forests of British East Africa, and perhaps in the westernmost parts of the Uganda Protectorate, there is the remarkable black forest pig (*Hylochoerus*). The wart hogs are an extreme development of this type, with enormous tusks, warty excrescences, and huge, broad heads. There are two

species at least, if not a third, under the British flag—one in the Egyptian Sudan, another in British East, Central, and South Africa, and perhaps a third in West Africa.

In British West African possessions, from the Gambia to the western frontiers of Uganda, occurs the remarkable water chevrotain (see page 83), which descends almost unaltered from Miocene times, when it inhabited France and Germany. It is very nearly a connecting link between the pig group and that of the ruminants (deer and oxen). Among the antlered deer, the Empire claims the stag, or red deer, yet wild in Scotland, England, and Ireland; its magnificent relative, the wapiti, in Canada; and transitional forms between the red deer and the wapiti in Kashmir and North-Western India. In Canada and Newfoundland, also, the elk, or moose, still exists; and in Eastern and Northern Canada is to be found the handsome big subspecies of reindeer generally known as the caribou. India, Malaysia, and Ceylon possess the large, unspotted sambar deer in various forms, and a large type of Siamese deer, with great development of antlers; the spotted hog deer, and the singularly beautiful axis, in which the white spots and stripes are carried to a development not known in any other cervine. Here also are found the muntjacs, a primitive type of deer, with large canine tusks and with short antlers starting from very long, bony pedicels.



THE EXTINCT DODO OF MAURITIUS

A large pigeon-like bird that has been exterminated in modern times

As to the Giraffe family, the okapi was discovered by the writer within literally a few miles of the western frontier of Uganda, in the adjoining Congo Forest, and in all probability this rare animal is actually a British citizen, as it is reported to exist in the forested regions of the Uganda Protectorate to the west and east of the river Semliki. In British Somaliland is found the remarkable Somali giraffe, a wine-red-coloured giraffe marked with a network of narrow white stripes.

Over the rest of British Africa occur all the sub-species of the other giraffe type, *Giraffa camelopardalis*, in the hinterland of the Gambia, in the Northern Gold Coast, Northern Nigeria, Egyptian Sudan, British East Africa—where we have the five-horned giraffe, discovered by the present writer,—in the central parts of British Central Africa, and in the central parts of South Africa and the Northern Transvaal.

With regard to the Oxen, the wild cattle of English and Scottish parks are descended from the Roman domestic cattle introduced into the British Islands, though we speak of them as wild white cattle. In Canada are still to be seen several herds, amounting to two or three thousand, of the American bison. In India are found the bison-like yak in the far north, and in the plains and forests of Tropical India and Malaysia the buffalo, or "arni," the magnificent gaur, and the smaller gayal. In British Africa there is the black buffalo with the bossed horns, which in slightly different types ranges from Lake Chad down to Cape Colony, as well as the red buffalo of the Gold Coast and Southern Nigeria and the extreme westernmost parts of Uganda.

Amongst the Capri-corns there may perhaps remain a few examples of that aberrant type, the musk-ox—which lived at Bath and Twickenham some sixty thousand years ago,—in Labrador and the north-easternmost parts of Canada along the shores of the Arctic Sea. In the north-easternmost parts of India, on the verge of China and Tibet, occurs the equally peculiar and remarkable takin, and in the Malay Peninsula and the Himalaya there are kindred serows, the southern forms of which are in

the Malay Peninsula quite large animals of rather striking colouring—black, bay, and white.

India is celebrated for its magnificent wild sheep, one of which—the Pamir variety—is the biggest wild sheep in the world. The western parts of Egypt contain the African wild sheep, or aouda. Cyprus has a wild sheep more akin to the Armenian mouflon; Western Canada, the Rocky Mountain sheep. North-Western India possesses an ibex and the big markhur goat with its spiral horns. South-Eastern Egypt and the Aden Protectorate still shelter two forms of the handsome ibex.

The British wealth in Antelopes is surpassing. In India alone are found the nilgai and the four-horned antelope. Most of the great and nearly all the lesser kudus are inhabitants of South, Central, and North-East Africa. In the Anglo-Egyptian Sudan is the giant eland, and the handsome Derbian eland is obtained from the hinterland of the Gambia and Sierra Leone, and perhaps exists in Northern Nigeria. And so might be enumerated the handsome bongo and other bushbucks, gnus and hartebeests, oryxes, gazelles, giraffe-gazelles, springbucks, and the Indian blackbuck. The Royal antelope of Sierra Leone and the Gold Coast is the tiniest of horned ruminants. The zebra duiker of Eastern Sierra Leone is among the rarest of small antelopes.

British rodents include the large, handsomely-coloured squirrels of India, Burma, the Malay Peninsula, and Borneo; the porcupines of Canada, West Africa, and Malaysia; a hare-like rabbit of Assam; the Arctic hare in Scotland and Canada; the large red Siberian hare in England. Egypt has its jerboas, while other jumping rodents are met with in East and South Africa; and of rats, mice, and voles endless is the story, though be it noted that in the harvest mouse England has the tiniest of all rodents.

Whales and porpoises are necessarily largely international in their range, but a dwarf genus of the whalebone whale occurs in the sea between Australia and New Zealand; the Ganges and Indus have a dolphin and the Irrawadi a grampus.

Among peculiar Seals and Sea Lions, several species frequent the British shores; the southern sea lion inhabits



THE WILD CATTLE OF CHILLINGHAM, NORTHUMBERLAND
From the painting by Sir Edwin Landseer, R.A.



SIR EDWIN LANDSEER'S FAMOUS PICTURE OF "THE STAG AT BAY"

the Falklands, Hooker's sea lion the southern shores of New Zealand, and the hair seal the southern coast of Australia; while a fur seal haunts the Falklands and South Shetlands, another the coasts of Cape Colony, and a third those of New Zealand. Some peculiar and large seals are found along the Antarctic shores, such as the crab-eating seal and Ross's seal. Weddell's seal and the large, fierce leopard seals, though mainly Antarctic, range northwards to the Falkland Islands and the extremities of Patagonia and New Zealand. The treatment of the wonderful sea elephant is, from a faunistic point of view, a grave scandal in the history of the British Empire. This amazing seal—the size and bulk of an elephant—at one time resorted to the Falkland Islands, and especially to South Georgia and the South Shetlands. For the sake of their oil we have allowed them to be massacred and massacred till now only very few are left.

British land Carnivores include the lion; the tiger; the leopard; the jaguar; the clouded tiger of Malaysia; the lynxes in India, East and South Africa, Egypt, and Canada; the puma and ocelot in British Honduras, and perhaps Guiana; most of the types of wild cat; and the hunting chita of India, East and South Africa.

Among noteworthy Canines we have the long-eared *Otocyon* in Somaliland and South Africa; and a very remarkable wild dog in British Guiana (*Speothos*), which is in appearance much less a dog than (superficially) a weasel, with its short, rounded ears and short legs. In South and East Africa there is the handsomely-marked black-backed

jackal, orange, grey, white, and black in colouring. India and Malaysia abound in wild dogs; and Canada, besides possessing wolves of more or less European type, shares with Alaska the wild dog, or wolf, of large size and chocolate-black-coloured hair, the so-called Alaska wolf.

Canada has sables, martens, and most of the fur-bearing weasels. British Africa has handsome black and white weasels (*Pæcilogale*), and India and Africa the large black and grey ratel. The glutton is found in Canada; there are British as well as Indian and Canadian badgers; and skunks are found in Canada as well as in British Honduras. Among the civets there are the extraordinary black binturong of the Malay Peninsula, the large African civet, which supplies the perfume still valued in commerce, and the Indian and Malayan civets, besides many species of genet and allied creatures in South Africa, East Africa, West Africa, India, and the Malay Peninsula. Within British bounds occur all the species of hyæna of which the brown hyæna is monopolised, probably, by the eastern parts of South Africa.

Regarding the Bears, the north-westernmost parts of Canada may perhaps share with Alaska the splendid chocolate-coloured Alaska bear. British Columbia, at any rate, has the grizzly bear and the black bear; and the white Polar bear is found in the northern and north-eastern parts of the Canadian Dominion. In India we have the Syrian bear, the sloth bear, the black bear, and in Assam and Malaysia the small honey-eating sun bear.

The British Empire possesses within its political limits nearly all the genera and a large proportion of



THE MYSTERIOUS AARDVARK OF BRITISH AFRICA
This ungainly earth-pig, of nocturnal habits, lives on ants and termites

the species of Bats. Specially noteworthy are the long-tailed fruit-eating bats of New Guinea and Fiji; the appallingly hideous fruit-eating bat of British West Africa (*Hypsignathus*); and among insect-eating bats, the horseshoe genus of England and elsewhere, the *Anthops ornatus* of the Solomon Islands, with an enormous nose-leaf, the brilliantly-coloured orange-brown-cream *Kerivoula picta* of Ceylon, the still more beautiful orange-white-sepia harlequin bat of the Himalaya, the white-winged, chestnut-brown-bodied *Scotophilus albobfuscus* of the Gambia, the creeping, climbing, narrow-winged *Mystacops tuberculatus* bat of New Zealand, and lastly the true vampire blood-sucking bat (*Desmodus*), which is found in British Guiana as well as in other parts of South America.

The order of Apes and Monkeys is well represented in British dominions. In Southern Nigeria are two peculiar forms of lemur; in parts of British Africa are several species of galago; and in Ceylon the loris, and in Malaysia the altogether remarkable and peculiar tarsier. In Guiana and Trinidad some of the American marmoset and monkey types are represented. In British Africa we have an extraordinary array of Old World monkeys—all the species of colobus, nearly all the cercopithecines, and at least one peculiar species of mangabey. On the Rock of Gibraltar exist the only remaining monkeys of Europe, identical, however, with the macaque of the Morocco coast. In India and Malaysia the genus *Semnopithecus* and its allied type, the proboscis monkey,

are well represented. The British baboons include all the known species of that group, not excepting the mandrill and drill of West Africa, and the extraordinary gelada of Northern Somaliland. The great apes are represented by the gorilla of the south-westernmost portion of the Uganda Protectorate, by several forms of chimpanzee in Uganda, the Egyptian Sudan, Southern Nigeria, the Gold Coast, and Sierra Leone, by the orang-utan of British Borneo, and by the gibbons of Assam and the Malay Peninsula.

Lastly, there is Man. Within the limits of the Empire nearly all human types are, or have been, represented—the Australoid in Australia and Tasmania, and perhaps in Ceylon and Southern India; the Negro and Negroid in the Andaman Islands, the Malay Peninsula, the Solomon Islands, New Guinea, Southern India, and all British Africa. Almost peculiar to British Africa is the Bushman variety of the Negro. Congo Pigmies are found on the western frontiers of Uganda. The Caucasian is represented in the British Isles, Malta, Cyprus, Egypt, India, and Canada; the Mongol in India, Malaysia, Hong Kong, and Borneo; the Eskimo and the Amerindian in Canada, Honduras, Guiana, and the British West Indies; and the Melanesian and Polynesian hybrids in New Guinea, New Zealand, Fiji, and Tonga.

H. H. JOHNSTON



THE ARGALI, A FINE MOUNTAIN SHEEP, OF THE HIMALAYA

ANIMAL LIFE AT THE EQUATOR

STRANGE DENIZENS OF THE TROPICAL REGIONS

By Sir HARRY JOHNSTON.

At the present day the Equatorial regions of the earth's land surface are undoubtedly the most densely populated by all forms of life, excepting man; and the deficiency of man, as compared with the countries farther north, is due in the main to the fact that the land surface of the Equatorial zone—and in this argument "Equator" is equivalent to a belt round the middle of the earth 1,400 miles broad—is far less in area than the vast regions lying beyond this central girdle of heat and moisture.

Yet the fact cannot be evaded that civilised man of the Caucasian subspecies has not taken kindly as yet to the colonisation of Equatoria; although this portion of the earth's land surface, even if it be much smaller in extent than the north-temperate or subtropical regions, is proportionately far more productive, being everywhere well watered, endowed mostly with a rich, not to say rank, soil, and possessing enormous forests, many of them replete with vegetable food-stuffs and a remarkable assortment of wild beasts, birds, reptiles, fishes, and crustaceans suited for human food. It is also highly mineralised; in short, it is the richest region of the earth.

In all probability man originated in the tropics of the Old World, perhaps in India or Further India, not far from the Equatorial region, or in the great Malay Islands. If not in Southern Asia, then the only alternative suggestion, so far without evidence, seems to point to Western Asia or Eastern Europe as the cradle of the human race.

But as soon as Man arrived at full consciousness of his own powers, though he migrated in all directions—south, east, west, and north—he throve most, advanced most towards the mastery of the beasts of the field and of the earth itself in Temperate Europe and Asia, in North and South America. We are entitled to surmise that very early in his human career he shunned the dense forests that combined heat and moisture, and preferred a life on the more open plains and plateaus of cooler regions wherein he could develop his powers as a hunter to the greatest advantage.

Still, though at the Equator man is at his weakest—for in the Antarctic and Arctic, though few in numbers, he is still the master—will it be always thus? Probably not. His only real enemies in this richest

part of the earth are intestinal worms; and those micro-organisms, vegetable or animal, which are introduced into his blood from the already infested human inhabitants indigenous to the Equatorial belt. One means of introduction is now well known to be certain forms of insect or tick. Cure by prophylactic the indigenous peoples of the Tropics; expel from their systems these parasitic worms, bacteria and protozoa; destroy the transmitting agencies—in sanitary habits, mosquitoes, flies, fleas, ticks—and you will rid the Equatorial belt of three-fourths of its unhealthiness for the Caucasian and his cattle.

But here, again, the actual configuration of the land surface in this belt of 1,400 miles broad to a considerable extent neutralises the evils attendant on perpetual summer, unrelenting rain, never-varying heat. At least a fifth part of Equatorial Africa is at such an altitude above sea-level that either its rainfall is lessened and its sunshine cooled, or, if still moist, it is at any rate cool enough at night-time to admit of sound, refreshing sleep, thus enabling the body of the white man to remain in full vigour. Still more is this the case in Equatorial South America, which is becoming emphatically a white man's country. The lofty snow-topped mountains of New Guinea will certainly some day be the home of a powerful white nation, and white

men are even now able to maintain health and vigour in Java, Sumatra, and the Malay Peninsula, in Ceylon and the Nilghiri region of Southern India. Even North Borneo gives us Mount Kina Balu for a sanatorium.

But, it may be objected, why speak of the white man only? May not a high civilisation arise and flourish and be perpetual which is directed by black men and yellow men free from white intermixture? Quite possibly; almost certainly so in Equatorial Africa; but in the other regions of the Equatorial belt in America and Asia

the white man has got the start, the indigenous inhabitants of these regions, except in India and Ceylon, being neither sufficiently numerous nor sufficiently powerful to compete with him on their until recently uninhabited mountains. Nor are India and Ceylon quite exceptional, inasmuch as both regions were conquered and permeated racially thousands of years ago by our Aryan congeners from Temperate Asia.



THE WATER CHEVROTAIN

A remarkable primitive ruminant in Equatorial Africa. From a photograph of a living specimen obtained by Sir Harry Johnston

There are many indications in the geological history of life on the earth's surface, and in the present and past distribution of living forms, to suggest that there were two principal areas of fruitful evolution in plants and animals: one—greatest of all—in the Eurasian-American regions grouped round the Arctic Circle, and the other—South America-Australia-South Africa—radiating from Antarctica. We know for a fact that the present vegetation of Florida and of Pliocene Europe existed before the Pleistocene cold as far north as Northern Greenland, within a few hundred miles of the Pole. We also know that vegetation must have been sufficiently abundant at the South Pole for its remains to have become compressed into thick strata of coal. It is easy to suppose that before the Pleistocene or the beginning of the Quaternary epoch there may have been no ice cap at either Pole, but temperatures approximating to those of modern Italy or France. Yet it is difficult to understand how forests of magnolia, cypress, and oak could have endured the six months' darkness of the Arctic Circle in Northern Greenland, or the forests of Antarctica—which made the coal discovered by Sir Ernest Shackleton—have similarly existed despite the absence of the sun for half the year. However that may be, there were evidently once the two great centres of life-swarming, namely, the Northern land area of Eurasia-North America, and the Southern of Antarctica-Patagonia-Australia, conjoined with South-West Africa.

During the second half of the lengthy Secondary epoch—the age in which reptiles were reaching their culmination, but mammals and birds were both increasing and diversifying—the distribution of the earth's land surface seems to have been very different, and this difference to have continued down to early Tertiary times. We are entitled to presume that in these ages of the reptile supremacy and the expansion of the mammalian class there was a good deal more land exposed for the habitation of animals in the southern half of the globe—a continental mass of fanciful outline which united Africa south of the Sahara Desert, the Sudan, and Somaliland with South America mainly by way of a broad isthmus across the Equatorial Atlantic, and again by a great continental expansion in the South Atlantic, of which St. Helena, Ascension, and Tristan d'Acunha are the last vestiges.

At the beginning of the Tertiary epoch Brazil-Guiana was a great peninsula, almost an island, but precariously united—sometimes by isthmuses, sometimes by chains of islands—with Andean South

America, with West Africa, and, to a certain extent, with the Antilles. Much of Central America lay under a broad stretch of sea which separated the Northern from the Southern Continent. These Cretaceous or Eocene waters flowed over a good deal of what is now North America, and parts of the West Indian Islands. And probably from the middle of the Secondary epoch to the Eocene Tertiaries, South America was united, not only with its African neighbour, but also with the Antarctic Continent by way of the South Shetland Islands. Antarctica again extended northwards till it connected with Tasmania and Australia and came very near to New Zealand.

In contrast with this, much of Northern and Central Australia, Malaysia, and India was under water; the lime-depositing seas of the Secondaries flowed over a good deal of Somaliland, the Nile Valley, the Libyan and Sahara Deserts, Eastern and Southern Europe, the valleys of the Amazon, Orinoco, and Paraná; so that there was not nearly so much of the Equatorial belt in the occupation of plant and animal life as there is at the present day.

Then as great changes in the earth's surface took place during the Tertiary and Quaternary epochs—low continents subsiding under shallow seas, land emerging above the surface of the ocean, the Alps, the Himalaya and Central Asian mountains rising into great altitudes, the Arctic Ocean retreating from Siberia to the Polar zone; the Antarctic and South Atlantic waters invaded those lands which once united Africa with South America, and South America with Antarctica and Australia. Meanwhile

Africa became the huge, continuous, torrid continent we now behold.

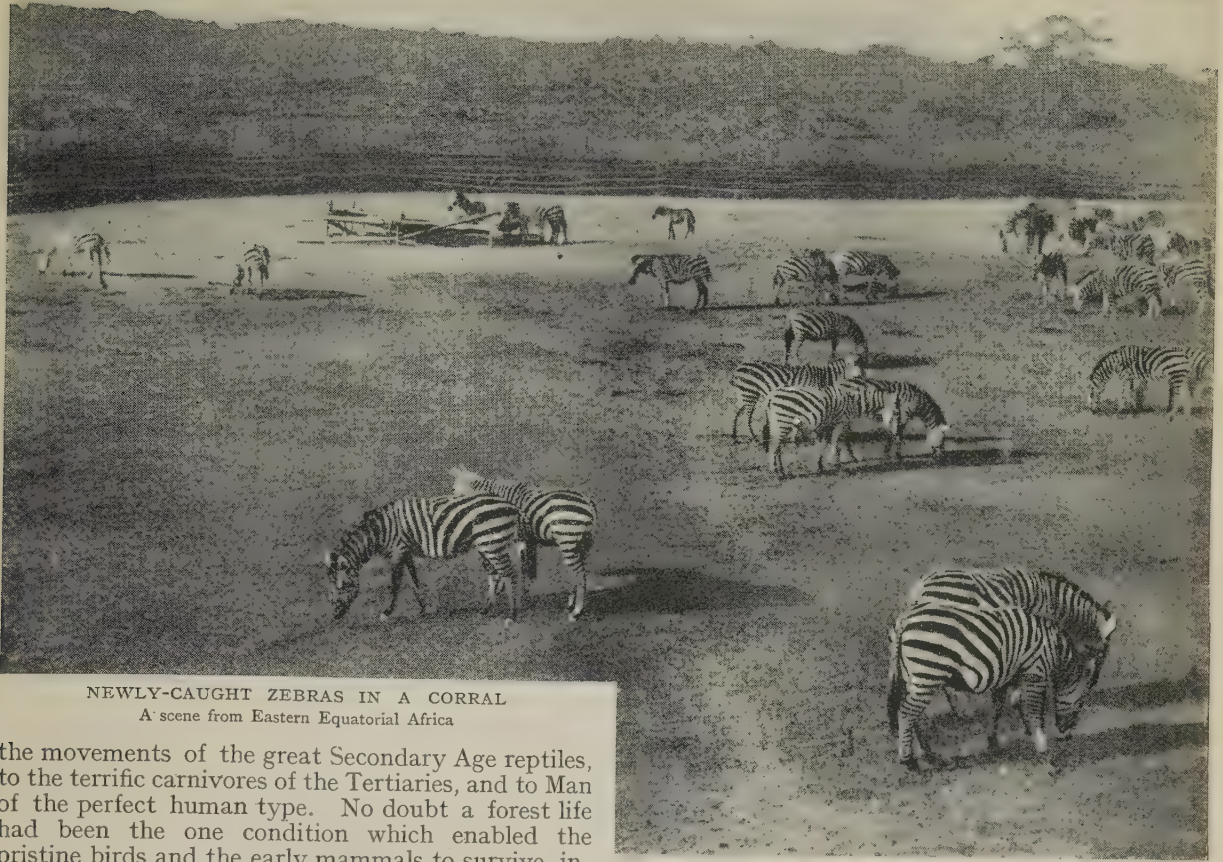
By degrees, as land masses grew greater and more continuous round the Equatorial belt, water and cold prevailed in the far North and the far South. The Glacial periods began which have not yet finished, for the ice still locks up and renders useless an immense area of over five million square miles of land in Antarctica, Greenland, Northern Canada, Northernmost Europe, and Northern Asia.

The advancing frigidity drove the majority of living things towards the Equatorial belt. It was

here, most of all, that plant life flourished, and the excessive development of forests in Equatorial America, Africa, and Asia served as a shield to protect ancient types which dropped out from the struggle for existence in the hustle, bustle, and competition prevailing over the open country of the temperate and subtropical regions. The forests of Equatoria were, of all conditions, most hampering to



THE ZEBRA ANTELOPE OF LIBERIA
A rare denizen of Equatorial West Africa



NEWLY-CAUGHT ZEBRAS IN A CORRAL
A scene from Eastern Equatorial Africa

the movements of the great Secondary Age reptiles, to the terrific carnivores of the Tertiaries, and to Man of the perfect human type. No doubt a forest life had been the one condition which enabled the pristine birds and the early mammals to survive, increase, multiply, and prosper, in spite of the presence on the earth of many families of dinosaurs and other monstrous reptiles. The bird itself may have been an early branch of the dinosaurs which took to a life in shallow water, alternately wading and flapping its way with its fin-like upper limbs along the surface of the water. But it soon evaded the attacks of its foes—and yet attached itself more particularly to the pursuit of its favourite insect food—by taking to a tree life, during which its clumsy fin-like upper limbs developed into wings. The mammal, originally, no doubt, a smallish creature about the size of a fox or dog, also took to the forest in pursuit of insects and small reptiles, and further because in the forest no great pterodactyle could swoop, no monstrous dinosaur could penetrate, no crocodile ascend—and pythons and poisonous snakes had not yet arrived. The forest, again, since the Pliocene, has enabled the imperfectly developed anthropoid apes still to linger on the earth's surface out of reach of their enormously successful cousin of the genus *Homo*. The gorilla, chimpanzee, orang-utan, and the largest of the gibbons (the siamang) are entirely confined in their present-day distribution to the Equatorial forests of West and West Central Africa and Malaysia. The forests of Central and South America and Malaysia hold the three living species of tapir.

Tapirs once inhabited England, France, and, above all, Southern Germany, from the earliest Miocene

period through the Pliocene. But they seemingly never entered the more open lands of the Mediterranean basin—thus they never reached Africa,—but remained in the presumably dense forests of Central or Eastern Europe until the competition with more highly evolved forms became too fierce, when they either died out or migrated eastwards through Central Asia to China, Indo-China, and Malaysia.

In like manner the okapi, a humble relation of the gigantic giraffe, and probably a beast which was evolved in the early Pliocene in Greece or Asia Minor, must have fled southwards through Egypt and the Nile Valley till it found a refuge and a respite in the Equatorial forests of the Congo, amid which even British sportsmen will find it difficult to effect its extermination.

The Equatorial regions of Africa and India—and to a less marked extent Malaysia—have much in common in their fauna and flora. Besides the anthropoid apes, there are buffaloes of a rather primitive type in Western Equatorial Africa and in Easternmost Equatorial Asia. There are the only living representatives of the Tragulina, primitive ruminants almost midway in their structure between the pig and the deer, and once native to Europe and North America. The most remarkable of the living forms is the water chevrotain of Equatorial Africa. Liberia and the Equatorial portion of the Congo basin and of the Cameroons are the

home of peculiar and local types of cephalophine antelopes. In the Equatorial forests of Southern Asia there are splendid wild cattle, notably such species as the gaur or seladang, and banteng. In this region also is the curious tarsier-lemur, and there are equally strange lemurs—the potto and the angwantibo—in the Equatorial forests of West Africa. There are the slow lemurs of Malaysia, and the slender lorises of Southern India and Ceylon. The Equatorial belt of West Central Africa has some extraordinary flying rodents—the anomalures, squirrel-like in appearance, and not very distantly related to the squirrel family. Equatorial Eastern Asia has the galeopithecus, another flying mammal placed in an order by itself, though it possesses distant affinities with the lemurs and insectivores. In the same region of Equatorial Asia are the tupaias—squirrel-like insectivores remarkable for their lemurine affinities and strong superficial resemblance to the squirrels. The largest and handsomest of the squirrel race are found in the same countries. West Africa also has large and beautifully-coloured squirrels, such as Stanger's squirrel, the size of a small rabbit, and with a portion of its fur of a brilliant orange, matching closely the orange oil-palm nuts on which it feeds.

Equatorial South America has its own strange and remarkable rodents, the capybara—largest of living gnawing animals which leads a water life—the agutis, and the white-spotted pacas. The Equatorial belt of South America is not so rich in mammalian forms as that of the Old World, but it has developed the peculiar vampire bats, which extend their range into Tropical America beyond the Equatorial belt; the South American monkeys and marmosets, the greater number of the genera and species of which are confined to the Equatorial

belt; and a remarkable number of opossums, the principal American marsupial, of the genus *Didelphys*. Yet the didelphine marsupials do not seem to have been originally Equatorial in their distribution, but to have been numerous in North America, Northern Europe, and Temperate Asia. From the last-named region they

probably reached North America, and thence found their way in late Tertiary times to the Southern Continent, where they have multiplied and prospered. No doubt this generalised and rather basic type of marsupial reached Malaysia, New Guinea, and Australia from Asia in the later Secondaries or early Tertiaries, and there gave rise to the extraordinary present development of marsupials of

the two very distinct suborders, the polyprotodont and the diprotodont, distinguished by the many or the few incisor teeth in the lower jaw. Both the dasyurine family of the polyprotodonts and a few of the diprotodonts apparently travelled southwards across Antarctica to South America, where their remains are found fossil in Patagonia. But one genus—*Canolestes*—of the South American diprotodonts has survived extinction, and in two species inhabits Equatorial Colombia and Ecuador at the present day.

In Equatorial New Guinea and in the northernmost regions of Australia are the interesting tree kangaroos, and in the Equatorial Malaysian Islands are the handsomely marked cuscus phalangers. Equatorial Asia has its peculiar species of rhinoceros, the rhinoceros of the Sunderfunds, with one horn, and the Sumatran species, with a hairy variety, with two horns. In Equatorial Africa the rhinoceros genus is only found in the eastern and less-forested regions. Both continents possess the elephant within the Equatorial belt, but the elephant of the densely forested portions of Western Equatorial Africa—possibly Liberia, and certainly the Kamerun and North-Western Congo—is a smaller species or subspecies, with ears much reduced in size as compared with the average African elephant; while there is also a smaller type of Asiatic elephant in Easternmost Equatorial Asia.

As regards carnivores, Equatorial South America, Guiana, and Northern Brazil possess a very strange weasel-like dog—*Speothos venaticus*. Equatorial South America is also the home of peculiar types of the raccoon family, such as the *bassaricyon*, the kinkajou, and the *coati mundis*; also of two curious one-coloured cats, the *jaguarondi* and the *eyra*. Equatorial Africa has, like Asia, some peculiar civets;

and Eastern Asia has the extraordinary-looking binturong and cynogale, the last an otter-like member of the civet family. Equatorial East Africa has the aberrant aard wolf, a dwarf ally of the hyenas, though this creature extends its range into South Africa. Equatorial Malaysia possesses one of the handsomest



A HIPPOPOTAMUS IN A POOL IN A SOUTH CENTRAL AFRICAN RIVER

cats in the world, the beautiful clouded tiger. Easternmost Equatorial Asia also has some surviving marvels—the babirusa pig, with its upper tusks growing vertically through the bones of the face, and the repulsive but interesting Black ape of Celebes, a distant ally of the baboons. Borneo has a monkey with an enormous nose, that procures for it the name of proboscis monkey.

ANIMAL LIFE AT THE EQUATOR

Equatorial Africa possesses notably the gorilla and the chimpanzee; also, in its westernmost forests, the drill; and in those of the more central regions, the mandrill—two strangely hideous baboons with huge heads and raised ridges of coloured skin on the face. There are also in these Equatorial regions many species of the *Cercopithecus* and *Cercocebus* genera; and all the colobus monkeys are peculiar to Equatorial Africa.

Amongst Equatorial edentates there are the large and small anteaters, the sloths and armadillos of Tropical and Equatorial America (especially of Brazil), and the scaly pangolins of Western Equatorial Africa and South-Eastern Asia.

Amongst Equatorial antelopes should be noted the giant eland of the South-Western Egyptian Sudan, and the equally splendid derbian eland of the West African forests; also the most beautifully coloured of all the antelopes—the bongo tragelaph of Equatorial Africa, its range extending from Sierra Leone and Liberia on the west, to the East

African highlands on the east. Equatorial Asia has several peculiar species of deer. Equatorial America has the red brocket deer of Guiana, and the remarkable little pudu deer of Ecuador. Among equatorial bears are the spectacled bear of the Peruvian Andes, the sun bear of Malaysia, and the sloth bear of India and Ceylon.

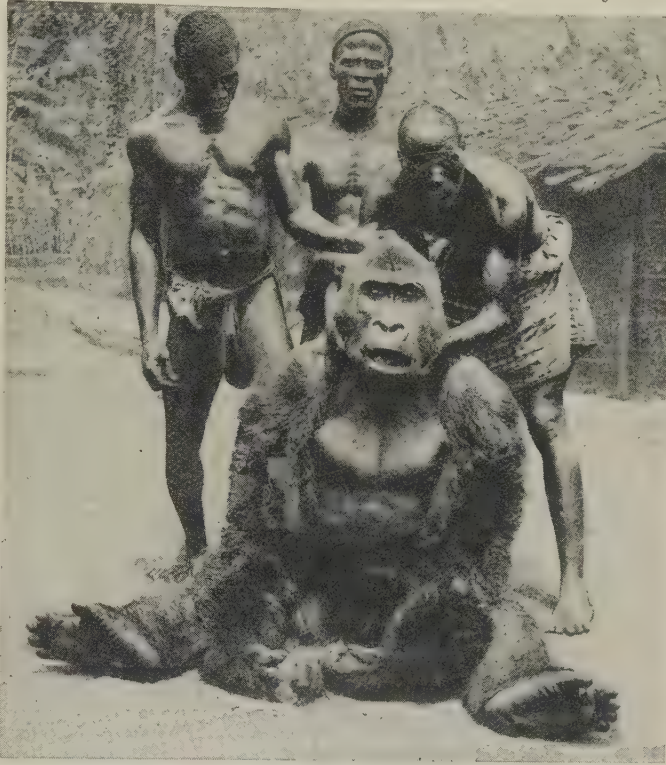
At least three genera of the African guinea-fowl are restricted to the Equatorial regions. In Equatorial America is the interesting family of tree-dwelling gallinaceous birds, the curassows, whose nearest allies, perhaps, are the megapodes of Equatorial Eastern Asia, New Guinea, and Northern Australia. The grey parrot is an Equatorial bird in Africa; so are the macaws in America and the lorries in Asia and Polynesia. The black cockatoos of New Guinea and Northern Australia are most remarkable bird forms. Still more famous are the birds of paradise of Equatorial New Guinea and the adjacent islands. The hoatzin of Guiana is one of the world's few remaining "missing links," a survivor from a far-distant "generalised" past. Its possible allies, the great blue plantain-eaters, violet and crimson plantain-eaters, green, purple, and crimson-winged turacos of West Africa are notable birds of the

Equatorial zone; so equally are the amazing emerald and crimson trogons of Central America, Colombia, and Peru, and the surpassingly lovely fruit pigeons and extravagantly grotesque hornbills of Equatorial Asia and Papuasias.

Allusion has already been made to the presumed land connection between Africa and South America across the Equatorial belt, and also in the region of the South Atlantic. In the form of a chain of islands this link between the two continents must have remained in the Equatorial zone down to as late a period as Miocene times, to account for the close relationships still existing between African and South American monkeys, sirenians, rodents, bird families and orders, snakes, spiders, fresh-water fishes, land crabs, land shells, etc. But the student of the Equatorial distribution of what might be called Miocene and Pliocene life-forms is frequently tempted—with very little geological or hydrographical evidence, as yet, to sup-

port him—to conjure up the existence down to the beginning of the Quaternary epoch of a variable land belt in the region of the Equator across the Pacific Ocean connecting Malaysia and Papuasias with Central and South America; or at any rate a series of islands separated from one another and from America by narrow straits of sea not impassable for man in a primitive stage, for mammals able to swim or fly, for birds, insects, crustaceans, or land shells.

There is the case of the tapir, for example. The Asiatic tapir exists at present in Tropical or Equatorial Malaysia, its range extending southwards as far as Sumatra and Borneo. In the rest of the world, living tapirs are only found in Tropical or Equatorial America. In Central America—Mexico to Panama—there is a peculiar subgenus, *Elasmognathus*, which differentiates into two species, Baird's tapir and Dow's tapir. Elsewhere in South America there is the well-known South American tapir, with a mountain species or variety, Roulin's tapir, in the Equatorial Andes. But it is remarkable that the common species of Brazil is less different in some of its structural features from the Malay tapir than it is from the Central American tapirs of the *elasmognathine* subgenus.



A GORILLA SHOT IN GERMAN WEST AFRICA
This anthropoid ape weighed 500 lb., stood 5 ft. 5 in. high, and measured 8 ft. from finger to finger

We know that the Asiatic tapir extended its range into Southern China down to a few thousand years ago, and that on the American side there were tapirs, apparently of the existing genus, living as far north as California and South Carolina. Was there some vanished land connection of Pliocene or Pleistocene times which united Eastern Equatorial Asia with Western Tropical America? Or did the tapir genus enter America by way of Kamchatka, the Aleutian Islands, and British Columbia before the beginning of the Pleistocene cold? Of course, there is another solution: the tapir family probably originated, like the rhinoceroses, in Eocene or Miocene North America, and spread thence to Asia and Europe by the northern land connections, ages before there was any menace of glacial conditions. But the actual genus *Tapirus* seems to have been evolved early in Pliocene Europe, and to have emigrated thence to Asia. Its nearest known relation in North America may have been *Tapiravus*, which has not been found in European formations; but unless it descended directly from that form, and is a case of parallel, converging development, the true tapir must either have had Alaska for its seat of origin, and thence have migrated southwards to its present homes in Equatorial Asia and America, or have found its way from Asia to America at a later date and by a more southern land route.

Man himself offers an addition to this puzzle in the geographically far-removed affinities between certain living types of Western Equatorial Asia and America. Despite the general similarity of the American aborigines, the "Amerindians," one cannot fail to remark that, after accounting for much intermingling, they fall naturally into two types: (1) a slender, rather short-legged, flat-faced, small-chinned, small-nosed people, whose black-brown hair is not without a slight tendency towards waviness; and (2) a robust, big-nosed type, of which the North-American Indian and the more successful peoples of Western South America are good examples. This type of robust build and big nose would seem to have come from the north and north-west, and may be the result of repeated Proto-Caucasian (Ainu-like) invasions from North-Eastern Asia,—migrations of the white race in ancient and modern times. But as regards type 1, who can refuse to admit its extraordinary physical resemblance to the indigenes of Borneo, to the Proto-Mongols of the Nicobar Islands, the Malay Peninsula, Indo-China and much of Polynesia? Place photographs—especially of unclothed types—of Amerindians from the Equatorial zone of South America alongside those of the Eastern Asiatic peoples already mentioned,

especially the Borneans, and the physical affinities are obvious. Not only that, but the resemblances in weapons, arts, industries, and customs of the Equatorial Amerindians and the Eastern Equatorial Asiatics are equally striking. Weapons and designs from the Amazon Valley match to a nicety those from Central Borneo, and frequently reappear among the Polynesians of the Pacific archipelagoes.

In the botany of Equatorial America and South-Eastern Asia, the affinities are equally striking. So also are the relationships between the most highly developed Tertiary groups of snakes, such as the blunt-headed snakes—non-poisonous, but allied to the vipers—and also the rattlesnake sub-family. In the case of these crotaline vipers there is one genus, *Lachesis*, which is common to Equatorial Asia and Equatorial America. So also is the species of sea snakes, *Hydrus platyurus*, which ranges from the coasts of the Indian Ocean, Western Pacific and Pacific archipelagoes, to the west coast of Central America and Panama. These sea snakes, despite

their aquatic life, resort to rocky coasts to breed, and otherwise frequent the neighbourhood of the land for their fish food. Therefore they are of littorine habitat, and are rarely met with at any great distance from land, though, no doubt, oceanic currents have something to do with their distribution.

The caiman-like alligator of mid-China—Yang-tse-kiang river—and the alligator and caimans of Tropical and Sub-tropical America are among the other affinities in the two faunas, and an additional connection may be traced in the Vejovidae family of scorpions and the Thelyphonidae family of "whip-scorpions." But the relationships of the birds

characteristic of the Equatorial belt in America are, besides their recent alliance with Sub-tropical North America, divided pretty equally between Malaysia, Papuasias, Polynesia, on the one hand, and West Africa on the other.

It is not easy to account for some Equatorial affinities, among forms obviously of late Tertiary origin, by obliging their ancestors—in theory—to journey for thousands of miles to the far north in order to find land communication across the Atlantic or the Pacific into the New World, of which they now only inhabit the Equatorial zone. Neither the Aleutian Isthmus, which connected Kamchatka with Alaska, nor the union of North-West Europe with Greenland by way of Spitsbergen, will suffice altogether to explain the intimate relationships in certain features between the Equatorial fauna and flora of America and those of West Africa, and also, in a lesser degree, of Polynesia, Papuasias, Malaysia, and Indo-China.

H. H. JOHNSTON



THE HEAD OF THE ELATE HORNBILL
From a drawing by Sir Harry Johnston

ANIMAL LIFE IN THE POLAR REGIONS

THE BIRDS AND BEASTS OF FROZEN LANDS

By AUBYN TREVOR-BATTYE

WHEN the mind ranges over all that has been recorded of adventure and enterprise in the Arctic and Antarctic regions it is apt to remember and dwell upon the sadder side of the picture, upon the barrenness, the desolation, the dreariness, upon the barely sustained fight of men's lives against the cruel forces of Nature—a fight constantly carried to all but the snapping-point of human endurance, against the fellness of the cold, the paralysing influence of the long Polar night. By many, therefore, these regions have come to be regarded as the land of death. It is apt to be forgotten that it is only civilised man, the intruder into a world of conditions opposed to himself, who is at this hopeless variance; that he is then really in a world of organic existences quite self-contained within their own limits, adapted by long ages of gradual change to their frigid and rigorous environment; that the white lands at the end of the earth are, in a phrase, not lands of death, but lands of life.

Let us take the Arctic regions first. It is impossible to consider the organic life of this area without touching upon its human life, upon those human beings of whom this region is the chosen home. Of these the best known are the Eskimo. Other human beings dwell in that Far North—in Greenland, Danes, but they are historically recent introductions—European settlers. The Eskimo are part and parcel of the native fauna; by immemorial influence of their surroundings as completely modified from the average type, and as completely adapted to their environment as are the plants and lower animals among which they move. Their range extends from Labrador nearly to the 80th parallel, and all but half-way round the world—as far, that is, as Bering Sea. Through all this immense distance they are able to communicate with one another in a common language, a fact that has no equal among any other people in any part of the globe. Whence they came and why they came are lost in the dimness of past ages. They have a culture that is all their own and exactly fitted to their needs, a language that is elaborately constructed, and they have very great inventive power. Beyond this, they have song and saga, and a distinct attainment in decorative and pictorial art.

So much has been said about them, not only by the earlier adventurers from the North-West

Passage, but of late years by Dr. Henry Rink and others, by the great explorers Nansen and Peary, that we are able to picture every detail of their daily life. We see these little people, their skin garments thrown aside, working in their curious dwellings all the winter through, shaping bows and arrows, working up horns of deer or tusks of walrus into weapons for the chase, and generally engaged in manifold preparations against the coming of the sun. Then spring breaks upon them, and the dog teams are straining at their collars, and with the opening of the leads in the ice the kayaks begin paddling in the sea.

But though the Eskimo dwell and wander further north by hundreds of miles than any other human beings, the Arctic lands of the Eastern hemisphere also have their own inhabitants. These are the races of the mainland of the Arctic littoral. Along that vast European and Siberian coastline roam the Samoyedes from Barents Sea to the Urals, the Ostiaks of the Ob, the Chuckchis of the Lena and Bering Sea.

These people, because land fails them, cannot range so far to the north as the Eskimo range; on the other hand, they are able to lead less isolated lives, for they, like the reindeer Lapps, are in touch with civilisation—such as it is—and trade

with the Russians for small necessities of life. Like the Eskimo, they are wanderers, but in their case it is from a different cause. For while some live chiefly by fishing in the great rivers, others must follow the reindeer, upon which their prosperity and even their existence depend. As the reindeer must shift from one pasturage to another, so their owners must go with them.

The tribes best known are the Samoyedes, and on the islands off the coast, only visited at rare intervals by anyone from the mainland, they are seen in their most primitive condition. They are not, like the Eskimo, dependent upon blubber, horns, and bone, for the drift from the great rivers

which is carried by currents out to sea and laid upon their coasts supplies them with material for many purposes. From this material—unpromising, and of the roughest description—cast upon their solitary shores they fashion sleighs, bows, arrows, traps for foxes, stockades for moulting geese, and many domestic articles. They live in wigwams,



THE MUSK-OX OF GREENLAND

This animal is considered by naturalists to be on the border-land between the sheep and the oxen



"MAN PROPOSES, GOD DISPOSES." SIR EDWIN LANDSEER'S FAMOUS PICTURE OF POLAR BEARS
This scene represents Polar bears sporting among the relics of Sir John Franklin's ill-fated expedition

or "chooms," covered with birch bark or with skins. Skins also form their clothing. They even use their sleighs in summer when the snow has melted, for these are so constructed that they can run over grass and pass easily across the summer bogs and swamps. These people are hospitable and courteous. Though they have not a written language, they keep records by means of symbols, and some of them, like the African Bushmen, can draw with quite recognisable accuracy pictures of animals and of hunting scenes. They have a system of religion akin to Shamanism, and the rites connected with birth and death are curious and interesting. Certain hills are held as holy, and dedicated to their deity, Nûm. When a man dies, his sleigh, his spear, his bow, or other object used in his daily life, is taken to the top of such a hill, and there is broken and left as evidence of his death and in propitiation of the god. The dead man is laid out on the moss of the *tundra*, or treeless plain, and deposited there under a rude covering.

The oral traditions of the Samoyedes have been carried down through very many generations; they regard their neighbours, the Ostiaks, almost with terror, as "very bad and murderous" people. Nothing, however, is known of any warfare, and scarcely of any contact between these two tribes within historic times; and it is therefore possible that this fear points to incidents of long, long ago, perhaps even as far off as the original migration.

Such, then, is a brief sketch of those human beings who, in the Arctic regions, stand at the head of the animal kingdom.

We will turn to some of the "lower" animals. Even at the northernmost extension of Greenland to the 84th parallel, wherever the borderland between the inland ice and the frozen ocean supports a scanty vegetation, there we find herbivorous mammals. It is the home of the musk-ox, one of the most singular animals in the whole zoological scale. It has affinities both with the oxen and the sheep. It is covered with woolly hair, has heavy horns with great frontal development, and lives in herds usually varying from twenty to thirty

individuals. Like all Arctic animals, they are exceedingly confident in the presence of man. There was a time when they lived in Europe, and a skull has been found in the Drift gravel of Norfolk.

The wild reindeer of the Arctic regions are also astonishingly fearless; the writer has known them come up quite close to him as he sat and sketched. And on one occasion they actually sniffed at the biscuit-boxes just outside the door of a traveller's tent, so that the occupant, Sir Martin Conway, was able to take a snapshot photograph of them at close quarters. Of course, in districts where they have been much hunted, this confidence has, to a great extent, been lost.

Terrestrial and amphibious carnivorous animals are represented in these regions by the Polar bear, Arctic wolf, Arctic fox, ermine, walrus, and various species of seal; ungulates, by the musk-ox and reindeer; rodents, by the hare and lemming; while in the sea live a remnant of the right whale, the narwhal, and certain species of rorqual. Were one to choose one animal rather than another as characteristic of the North Polar area, one would certainly choose the Polar bear. The "ice-bear," as the Scandinavians appropriately call it, seems indeed the very genius of the Arctic world. Without those structural modifications that characterise the seals, it is yet all but, if not quite, as amphibious as they are. The swimming powers of Polar bears are probably determined by questions of food; because, unlike the seals, they are not capable of swallowing their prey under water. Though these bears, therefore, are not, like the seals, subject to periodic migrations through great stretches of sea, they are capable of travelling wide distances in the water, and their hunting is largely done in that element. When a bear sees a seal lying near the edge of the ice, it slips into the water and dives, rising at intervals for breath. Nearer and nearer it draws, slipping along under water by the edge of the pack or the berg, only when it rises showing its face, and again silently sinking until within striking distance of the unconscious seal, when with a blow of its ponderous paw it kills its quarry (see page 56).

ANIMAL LIFE IN THE POLAR REGIONS

Male Polar bears roam about through the winter, and do not hesitate to cross stretches of land. I have, for instance, seen a considerable and well-marked track made by these creatures when passing backwards and forwards across the neck of the inhospitable island of Spitzbergen.

The white colour of the Polar bear is of obvious advantage as a means of concealment from its prey; and, indeed, it would seem that this white dress is given to some creatures as a blind for purposes of attack, to others for purposes of escape. The Polar bear, however, is the only Arctic animal which retains this colouring throughout the whole year. Others assume the white coat only on the approach of winter, and lose it again more or less in the spring. Thus the Arctic wolf is whiter in winter than in summer; the Arctic fox, like the Alpine hare, is blue or bluish brown in summer, but quite white in winter. In changing the coat this fox assumes the white first on the sides, and does not become white all over by a general and simultaneous change, so that during October and November it is a parti-coloured animal. The ermine, again, of the Arctic and sub-Arctic area, which is bright red in summer, assumes, by a gradual change, its white winter dress. Even in England, as is well known, the animal there called the stoat occasionally towards winter changes to pure white, and often to a pied condition. The exact influences which bring about this change are not understood; that it is not directly due to the action of cold on the nerves and pigment cells is evident, since the change may take place while the weather is still far from wintry. Among Arctic

birds, while there is perhaps only one—the ivory gull—white all the year round, there are some which assume in winter plumage more or less entirely white. Other examples are the rock ptarmigan, and, in the sub-Arctic area, the willow grouse and the common ptarmigan. It is easy to dispose of these instances under the convenient and alluring phrase “protective resemblance,” but the exceptions are the puzzle, as exceptions often are. The musk-ox is not white in winter; the caribou and reindeer, though whiter in their winter coats, are nowhere nearly white enough to be invisible in snow and safe from the sharp eyes of their inveterate foe, the wolf. It may be argued that in either case whiteness would be no protection from an animal that hunts by scent. What, then, of the

hare and, among birds, of the ptarmigan? To add to the puzzle, the cock snow bunting assumes his white plumage in the summer.

Is it not possible that phenomena such as these must have a very ancient origin and should be referred to the slow and gradual influences of great climatic periods? To those who incline to this belief these facts would then seem to indicate a state of gradual recovery from glacial conditions of unknown duration, but in any case prolonged.

Another very interesting fact about Arctic animals is the general absence of hibernation. The female Polar bear lies up in the snow at certain times, but this is connected with the birth of her young and is probably not an instance of true hibernation. We do not even know for a fact that she remains without food during this period; indeed, it appears exceedingly probable that she does not.

The lemming quite possibly goes to sleep at intervals, though this has never, so far as we are aware, been actually proved, but it is certain that a great deal of activity goes on beneath and in the snow, for as spring sets in their runs are seen everywhere. The creatures that seem thoroughly to hibernate are those on the border-line—the brown and the black bears, the marmot, the dormouse, for examples. If, therefore, we regard these animals as a migration from the East—and there seems to be some evidence that the dormouse is a wanderer from Asia—then we shall recognise that winter sleep overtakes them *as they approach* the direction of greater cold. Once over the line, it might seem that varieties have become species able to maintain



THE WALRUS, A CARNIVOROUS MONSTER OF THE ICE-BOUND COASTS
Its huge tusks, the canine teeth of the upper jaw, may measure 30 inches in length



THE NARWHAL, THE UNICORN OF THE POLAR SEAS

Its horn is probably used for fighting its enemies and as a means of catching its prey

their activity during the greatest cold, and hibernation has been dropped. There is, however, another theory of Arctic life, which is briefly touched upon on the next page.

Very few birds—perhaps not more than five species—remain in the Arctic regions throughout the winter. The rock ptarmigan remains there, and also the ivory and Ross's gulls. Ross's or the wedge-tailed gull, also called the rosy gull, because of a beautiful rosy blush diffused over its breast feathers when in breeding plumage, is one of the loveliest of birds. It will always have a pathetic interest for Arctic voyagers, for when the dead company of the ill-fated *Jeanette* were discovered, the devoted naturalist Newcomb still had beneath his shirt three skins of this rare bird, placed there for safety, and so carried through all that terrible struggle on foot from the wreck to the Lena delta. There is some evidence to show that the raven also remains in these high latitudes throughout the winter season; at any rate, this bird has been recorded as appearing in these regions with the very first light of the returning sun.

Spring brings back a large company of birds to the North Polar regions. While some—chiefly perching birds—arrest their migration in the Lower Arctic, and some at intermediate intervals between there and the Extreme North, others press on into the High Arctic, and a few almost to its farthest limits. Yes, when spring returns, a wonderful tide, so to call it, of bird life sets in towards the North Polar regions. The groups chiefly represented are waterfowl and wading birds—the “waders,” as they are generally called.

Most of the Arctic birds are familiar in the United Kingdom in autumn and winter, and many nest there, though the majority of those that do so stay nest and breed high up in the British Isles; but the breeding range of the waders varies very much, some nesting in the High Arctic, others barely reach-

ing the more rigorous regions of the Arctic world. The common snipe is a good example of the latter class. It is doubtful whether in the Western hemisphere it has bred north of latitude 70° (Greenland), but in the Eastern hemisphere it breeds in the Siberian swamps above the Arctic Circle. On the American side, wading birds are naturally referable to the American and Canadian mainlands, comparatively few crossing Bering Sea to the Asiatic side. As examples we may mention the pectoral sand-piper, Buonaparte's sand-piper, and the American stint. Of those waders

which are familiar on the English coasts in autumn and spring, but do not stay to breed, good instances are the knot and sanderling. The knot is one of those birds whose breeding-place was a mystery to ornithologists until a nest of young were found in Grinnell Land, $82^{\circ} 33' N.$, by the British Arctic Expedition of 1875-6. The winter plumage of this bird is made of shades of inconspicuous grey, but before they leave British shores many have begun to put on their beautiful red nesting dress.

The list of waterfowl that nest in the Polar area is a long one. The pink-footed goose—so numerous in winter on the Norfolk coast—nests in Spitsbergen, the white-fronted and the bean goose along the European littoral. The brent goose, essentially a sea goose and very familiar to all punt-gunners, possibly nests as far north as any migratory bird. One of the most noticeable of the ducks is the long-tailed duck, which is indeed a striking bird in its beautiful summer plumage, and although it is also found in lochs, it is, perhaps, more of a true sea duck than even the eider, and seems indifferent to the roughest sea, diving in the breakers as if in calm water. It is generally believed that seals feed exclusively on fishes, but this is not so, for the writer once saw one of these birds taken by a seal. He was watching a party of long-tailed ducks in open water among the ice, when suddenly the head of a seal appeared. The ducks settled further off, whereupon the seal vanished, but rose once more among the ducks, which again flew off. The seal raised itself high out of the water, looking round as a terrier does which has lost a rabbit, again sank, and again came up, this time successfully, for it caught a duck and took it under.

There are certain birds to which every Arctic voyager refers, because they are never long out of sight, and, indeed, come to be regarded as his familiar companions. These are the fulmar, the skuas, the guillemots, and the little auk.

ANIMAL LIFE IN THE POLAR REGIONS

The fulmar is the northern representative of a group of birds which is represented by species not only in British seas, but as far as the Antarctic regions; they are called petrels and shearwaters, and are characterised by having nostrils enclosed in a tube which extends along the bill. The fulmar, known to whalers as the "mollymoke" or "mollymauk," seldom, probably never, visits the land except at breeding time; it rests only, and very seldom, on the sea. To Arctic voyagers it seems to have an evil eye and never to rest, merely settling for a very short time to feed, and flying off again. Backwards and forwards it goes with wonderful untiring flight, as if looking for something it can never find. The skuas are gull-robbers; as soon as they see a gull which has food in its beak they set to work to chase it, and at last, by persistence of attack, succeed in making it drop its food, which, swooping down, they catch in mid-air. No bird is more clever than is either a Buffon's or an Arctic skua in its efforts to draw away an intruder from its nests; the helplessness one of these birds will then simulate is beyond belief.

The British common guillemot is represented in the Arctic region by a rather larger form known as Brünnich's guillemot. These birds are colonial cliff-builders, and each pair incubates a single egg on narrow ledges of the most precipitous places. A visit to such a "loomery," with its sounds from thousands of birds' throats and its bewildering confusion of myriad wings, is an experience which the explorer is never likely to forget.

Of the Arctic sea-birds two are especially beloved by all who have visited those waters—namely, the black guillemot, or "dovekie," and the little auk, or "rotje." The dovekie is a very beautiful little bird; its plumage is black with a white spot on the wing, and its legs are bright vermilion red. It nests in clefts in stacks of rocks. It has a pretty habit of constantly dipping its bill into the water. The little auk—a "dumpy" little bird, only $8\frac{1}{2}$ in. long—also nests in holes, but high up on the cliffs. One of these birds flew round the writer's head at an altitude of 3,000 ft., on the highest mountain in Spitsbergen. One of the most striking pictures of beauty in the memory of every Arctic explorer is that of the Polar calm: the sea quiet as a mirror, the lovely snow-white ivory gulls sitting upon the bergs of blue and green ice, and the dovekies and little auks floating in the water spaces among the ice. But so placid a picture may have a discordant note; as a shadow passes over the birds they dive for safety, for is not the shadow that of the ruthless pillager, the burgo-master, or glaucous gull?

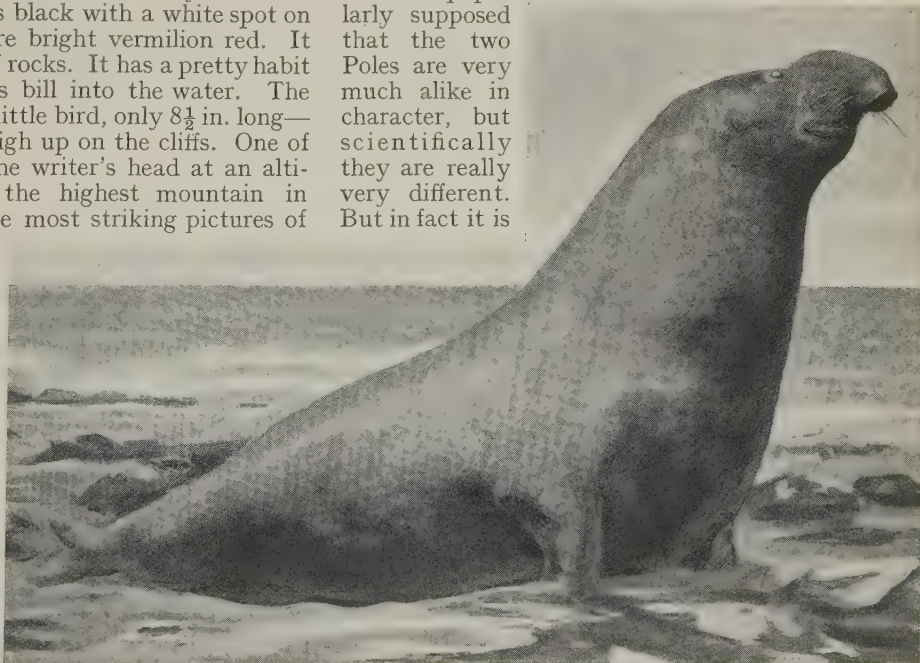
Two questions naturally arise out of what has gone before—namely these: first, "How did all these animals get there?" and, secondly, "Why do birds go there to nest?"

The first question is a very big one. To begin with, we must remember that the Arctic area was not always the frozen, inhospitable region that it is at present. To-day those seas swarm with pteropods and other lowly forms of animal life, but they were warm enough once to support even the frail life of the coral, while on the land the magnolia flourished. This is fact. Geology, which has shown us this, also points to another condition held as probability by many eminent scientific men. This condition is that in the Tertiary Period (*our* period) a great land causeway joined Europe with America. This would give continuity of organised life, and would explain the occurrence of musk-ox remains in the continent of Europe and the river drift in Norfolk.

Does not this also seem partly to supply an answer to the second question, that about the birds? Such movements become more intelligible to us when we realise that in them the birds are but obeying an old memory, a memory of the species that lies away back in the dimness of unrecorded ages—that in thus going up into the Polar summer to rear their young, they are really only *going home*. One of the most remarkable of all the facts of migration is that the young birds require no leading. In the very great majority of wading species it is the young birds which first arrive on British shores, while the old birds follow later, so unchangeably is the memory of the route to travel stamped upon the race.

This sketch reveals some of the points connected with Arctic life. Let us now turn to the Antarctic.

It is popularly supposed that the two Poles are very much alike in character, but scientifically they are really very different. But in fact it is



THE SEA ELEPHANT, WHICH IS LARGER THAN THE LAND ELEPHANT
The nose of this colossal seal is furnished with a proboscis, which the animal, when enraged, is able to inflate. The sea elephant is of vast proportions, measuring some 20 feet in length and from 15 to 18 feet round. Photograph by A. Rudland

scarcely an exaggeration to say that they have little in common except cold and ice.

To begin with, their geographical conditions are quite distinct, for one is water, the other is land. In the North Pole we have an ice-laden sea, studded with islands, but the South Pole is itself set in a great continent, which is contained in, and almost entirely fills the space included in, the Antarctic Circle. Outside of this lies the surrounding ocean, the nearest point of any continental mainland being Cape Horn, which, far from being within the Antarctic Circle, is some ten degrees distant from it.

Instead of the placid Arctic seas, the ocean that surrounds the Antarctic continent is constantly stormy, its immense rollers, unstayed by any land, having no parallel near the other Pole. No human beings live within this area, and no evidence has so far been discovered to show that any human beings ever did. This absence of human life forms one of the most striking differences between the areas we are comparing, and it is accentuated by the additional fact that no land mammals live there either. The only mammals are seals and whales. Readers of "The Heart of the Antarctic" will remember how its author describes the Bay of Whales in Victoria Land as teeming with life. He tells us that hundreds of whales, finners, killers, and humpbacks, were blowing all around, while on the ice were numerous groups of Weddell's seals.

One of the most remarkable of the Antarctic seals is the sea elephant. This animal has a loose, tubular sack of skin placed over the nostrils, which can be inflated and erected, and then resembles a short trunk. The bladder-nosed seal of the Northern seas has—as its name implies—a feature which can be distended in the same way. Another Antarctic seal is the southern fur seal. Unfortunately, it is only in high southern latitudes that these animals can now be found in any numbers, to such an extent have they been persecuted and killed off.

The bird life is also very limited, consisting only of penguins, petrels, and gulls, the first-named being among the most remarkable birds in existence. No living bird is more astonishingly adapted in form to suit the conditions of its life, its feathers modified to almost a scale-like covering, its wings like flippers, its legs situated far back—every feature has relationship to rapid progress in the water. On land it walks in an upright position, and bears a quaint resemblance to a human being. The

largest of the penguins is known as the emperor penguin, and these and the adelic penguin nest in immense colonies. These penguin "rookeries" have been often described. It is not easy to walk among the nesting birds, for they peck savagely at an intruder—indeed, a dog belonging to the Challenger was lost in one of these bird colonies. A most interesting fact is mentioned by Dr. James Murray, biologist to the Shackleton Expedition. He tells us that when the nesting is over, the emperor and adelic penguins deliberately feed up, and then set off to see the country. They appear to keep walking on for days and even for weeks without further food. Although several of the petrels are observed as far as the Antarctic Circle and down to the edge of the pack-ice, only one or two species reach the Antarctic continent itself. The snowy petrel, the sooty albatross, and even the Dominican gull have been recorded by each expedition as being observed about the edge of the pack, but only the giant petrel and Wilson's petrel appear to reach the land. These,

with the penguins and the Antarctic skua, alone among birds seem to redeem that inhospitable region from the impression of absolute lifelessness.

That the Antarctic region has had, like the Arctic, its period of warm seas is shown by the discovery in Victoria Land of a perfect specimen of a solitary coral. The Swedish Expedition under Nordenskiöld found on Seymour Island remains of trees, showing that during the Tertiary Period

this region had supported great forests. The Antarctic continent is now separated from Tierra del Fuego by a sea of 2,000 to 3,000 fathoms in depth, yet Nordenskiöld points out that these trees were in some instances similar to Tertiary forms he discovered in Tierra del Fuego, and that in Brazil allied forms are in existence.

In conclusion we may cite two very remarkable facts. The first is, that of five flowering plants found by Moseley on Heard Island, one (*Callitriche verna*) was a British plant. The other fact is that of the discovery by the Shackleton Expedition at Cape Royds of a rotifer (*Macrobrotus arcticus*), which, to quote Dr. James Murray, "is an Arctic species only previously known in Spitsbergen and Franz Josef Land." The day may come when we shall understand such problems; meantime each expedition brings back new material for study and new contributions to knowledge of the life of the Polar regions.

AUBYN TREVOR-BATTYE



A GROUP OF PENGUINS IN THEIR ARCTIC HOME

The wings of these strange birds have become flippers or paddles. Thus the penguins cannot fly, and they walk clumsily on webbed feet. From a photograph by Lewis Medland

THE INTELLIGENCE OF ANIMALS

THEIR POWERS OF REASON AND CAPACITY FOR EDUCATION

By Professor C. LLOYD MORGAN, F.R.S.

THE more fully the structure of animals is studied, the more extensive is the evidence in support of the conclusion that delicate adaptation to the conditions of life prevails throughout organic Nature. But the adaptation is in each case that which is practically serviceable, not that which meets the demands of theoretical perfection. Were this the appropriate occasion, abundant illustrations of this fact could be adduced. One must here suffice. There is perhaps no organ which is more admirably adapted to the needs of daily existence than the eye. And yet Helmholtz, the well-known German physicist, after prolonged and careful study, assured us that the eye has every possible defect that can be found in an optical instrument, and even some which are peculiar to itself. This may at first seem to be a somewhat sweeping condemnation. None the less, Helmholtz can speak of the adaptation of the organ of vision to its function as "most complete," and he urges that the completeness of adaptation is shown by the very limits which are set to its defects. The perfection is practical, not absolute. It is that which meets the demands of the conditions of its normal use, not those which the theorist may formulate. And whenever, taking a wider survey, we scrutinise the construction of physiological organs, we find the same character of serviceable adaptation to the needs of the organism.

On the theory of natural selection; this is exactly what we should be led to expect. In accordance with that theory, every animal has to submit to the most searching of competitive examinations in the struggle for existence. Only on condition that the organism, and its ancestors before it, have succeeded in passing this examination does the type which they represent persist. But the severity of the struggle is subject to some variation. As the examination becomes more searchingly stringent, the level of adaptation requisite for a pass—to keep up the metaphor—is raised. The relative perfection increases, but it still remains relative. Practical success suffices; theoretical excellence is not required. So long as the adaptation is sufficient, with a margin of safety, to secure the pass-mark of survival, all the biological conditions for the persistence of the type are fulfilled. Nay, further, the existence of organs, if such there be, whose

perfection is far in advance of the practical needs of their possessors would be evidence of the co-operation of some factor in organic evolution other than natural selection.

The elementary and, no doubt, familiar considerations which have just been advanced with regard to organic structure bear with equal cogency on the study of animal behaviour. The instincts and the intelligence of animals afford a fascinating but very difficult field of investigation—fascinating from its intrinsic interest and from its bearing on evolutionary theory; difficult because of its subtly inferential character. Unfortunately it has, until lately, been left too much in the hands of well-meaning but untrained amateurs, who have appealed for corroboration of their views to the common-sense of brother amateurs. In no department of the study of animal life has the amateur been given a freer hand; in scarcely any department are naïve, uncritical opinions of less weight and value. If the inquiry into the nature and psychological backing of animal behaviour is to be raised to something approximating to the level of scientific investigation, it must be prosecuted in accordance with accredited methods of careful observation and experiment by those who have undergone a suitable preparatory discipline; and conclusions must be drawn with due regard to scientific caution.

If, then, we attempt to bring the study of behaviour into line with that of zoological structure, and if we regard animal intelligence as of functional value for survival in the struggle for existence, we may do well to ask at the outset what characteristics we should expect to find in the mental processes of animals. Accepting evolution through natural selection

as a valid induction, we ask in effect what preliminary deductions we may draw with respect to the psychological status of the higher animals, assuming their mental processes to be practically effective to the end of survival.

Now, in order to be practically effective to this end, the behaviour of an animal must be of such a character as to enable it to secure an adequate amount of food of a kind appropriate to its needs. It must be of such a kind as to enable it to escape from its natural enemies. Neither of these objects



TWO TURKEYS "COURTING" A HEN
From a photograph by Professor B. H. Bentley

can be attained by the higher animals unless they have niceness and keenness of perception, to which sense organs of well-developed practical perfection afford the requisite data of experience. Nor can they be attained unless the organs of locomotion are fitted to their task, and unless all the motor activities are under complete control, with that delicacy of co-ordination which is essential to prompt and effective action. Nor, again, can they be attained unless the niceness of sensory perception and the delicacy of co-ordinated activity be brought into the closest and most accurate accord—unless, in a word, that which answers in the animal to the “training of hand and eye” in the child has reached a high pitch of serviceable perfection. Thus, in predatory mammals and birds, quickness to perceive their prey and to detect the subtlest indications of its presence or whereabouts, skill in its capture, like ability through keen perception and ready response to escape from enemies, enough wit to avoid or get out of the occasional difficulties incidental to life in a complex and changing environment—these are essential in order that intelligence should be a factor in survival. The presence of these, on the doctrine of evolution, we should be led to expect, and these assuredly we find. Add to these such instinct and intelligence as are necessary to enable the male to woo and win a mate—perhaps to woo, but in any case to win her—such instincts and intelligence, diverse in many ways, in accordance with the conditions of life, as are necessary to enable the parents to shelter and provide for the young till they are able to fend for themselves; such instincts and intelligence as further the common life of those animals which live in flocks, herds, packs, or other communities; such instinct and intelligence as enable the young to fall into the ways of their fellows among whom they are reared; such instinct and intelligence as fit them to range freely over their habitat. Add these and their like, for the list makes no pretence to be exhaustive, and we have before us the mental equipment which is practically serviceable to beast or bird in the struggle for existence. Keeness of perception, readiness of response, the ability to profit surely and swiftly by the teachings of direct experience—such are the saving graces of animal intelligence.

These saving graces are founded in heredity. There is, first, the hereditary ability to respond in certain adaptive ways to the surrounding conditions,

irrespective of any process of learning. This is the instinctive basis of behaviour which is always present, but is relatively predominant in the less intelligent animals. There is, secondly, the hereditary ability to profit by experience and to learn its lessons—what, following Sir E. Ray Lankester, we may term educability. This is most marked in the more intelligent animals. And there is, thirdly, in these more educable animals, an exuberance of vitality and varied response finding expression in a restless output of activity which is of the highest value both for the training of skill and for the acquisition of experience, since the animal, especially the young animal, is thus brought into relation with the greatest possible number of varied situations.

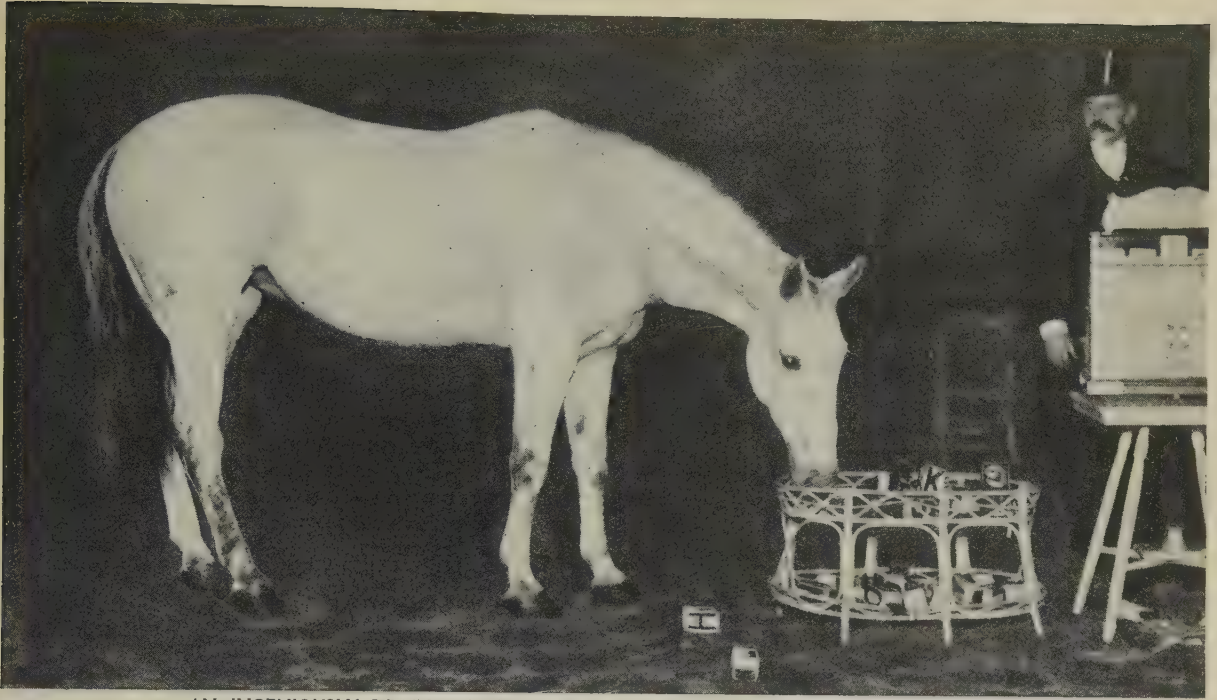
No one has done more to help us to realise the evolutionary importance of this third element than Dr. Karl Groos, through his able discussion of the so-called play of animals. Such play affords to the animal not only physical, but mental training; it is the necessary means to the full development of bodily power and of intelligent behaviour, and resourcefulness in emergency. In animal life the maxim “practice makes perfect” finds abundant illustration, and the biological value of animal play is that it is the field for the ready attainment of serviceable perfection through practice under conditions where the results of failure are not fatal.

This necessarily brief discussion of some of the essential characteristics of animal intelligence will no doubt be regarded by lovers of anecdotes as unsatisfactory, in that it lays stress on what they will regard as a lower order of intelligence, and altogether ignores the higher mental faculties. The aim, however, has been to determine on general grounds what is essential to survival—what kind of intelligence is practically effective in fitting the animal to obtain a pass in the stringent examination of life's struggle. It has, indeed, been suggested that just as, under natural selection, an organ does not reach a higher level of perfection than that which



A MILKMAN'S HORSE KNOCKING AT A CUSTOMER'S DOOR

is practically useful to the organism, so, too, on the theory of natural selection, we have no valid ground for expecting a higher level of intelligence in the animal than that which suffices for its daily needs and the continued preservation of its race. It will, however, be urged, and justly urged, that the question is not what we may have valid grounds for expecting on merely general



AN INGENUOUSLY TRAINED HORSE SPELLING OUT A WORD FROM LETTERED BRICKS

principles, but rather what we are bound to accept on the evidence of properly accredited observers.

We may, first, consider the evidence afforded by the remarkably clever tricks of performing animals. P. G. Hamerton, many years ago (1873), described how, in his own house, a cleverly trained dog would fetch in their right order the letters which spelt the English or German equivalents of common French words, and do other wonderful things. But the owner of the dog (M. du Rouil) admitted that there was a means of *rapport* between them which he was not prepared to divulge. A few years ago we read in the newspapers of the remarkable arithmetical powers of Kluger Hans, the calculating horse. The case is probably typical. Clever Hans gave, by tapping on the ground with his hoof, correct answers to the questions which were put to him. When told that the day was Tuesday and asked which number in the series of week-days this represented, he would tap thrice. Similarly, he would tell not only the hour, but the number of minutes indicated by a watch, the number of men and women in a particular row of visitors, the tallest and the shortest members of the party. In "Nature" (September 22, 1904), we are told that a representative committee, which included the director of the Berlin Zoological Gardens, a veterinary surgeon, and a professor of the Physiological Institute of the Berlin University, witnessed these performances with the view of ascertaining whether they were the result of trick, or whether they were due to the mental powers of the animal. Their verdict, it is reported, was unanimous in favour of the latter view. But in a letter to the same journal (October 20, 1904), the Rev. J. Meehan criticised this verdict and stated that the equally clever horse, Mahomet, had been taught, with

infinite pains by his trainer, to begin pawing the ground when his master looked straight at him, and to cease pawing when his trainer turned his gaze to the floor. Similarly, he had been drilled into bowing his head at one tone of his trainer's voice, and shaking it on hearing another. The same trainer showed Mr. Meehan how a collie would spell his own name and words sent up by the audience by bringing the right letters from an alphabet. The collie went along the letters, picked out the one he needed, and brought and laid it before the footlights. But the trick was really simple. His master carried his gloves in his hand. A little twitch of the gloves as the dog passed the particular letter wanted was the cue. The well-trained animal took in the slightest stir of the gloves with the corner of his eye. This dog even played a game of cards—and won. "I wonder," says Mr. Meehan, "what the German professors, good, easy men, would have said had they seen, as I did, Mahomet figure out a sum with his tail to the board!"

To return now to Kluger Hans. His wonderful performances were made the subject of further inquiry by a commission of psychological experts, headed by Professor Stumpf, of Berlin University. The conclusion they reached was that the horse was not capable of independent thought. I quote again from "Nature" (December 15, 1904): "When asked a question, Hans knows that he has to beat with his hoof in reply; but he does not know when to cease beating until he detects some movement on the part of the person questioning him. The commission expresses the opinion that, so far as Herr von Osten, the owner, is concerned, these movements are given involuntarily, and are sometimes of so imperceptible a nature as to be undetected save

by highly trained human observers. There has been no trickery, says Professor Stumpf, but, on the other hand, there have been no reasoning powers on the horse's part. The whole secret is in Von Osten's skill, patience, and judicious reward, and on Hans's part in keen powers of observation."

But what were the visual clues which appealed to these powers of perception? To this question the following reply is given by Herr Pfungst, who has published a memoir on the inimitable Hans (Berlin, 1905). "After Herr von Osten had stated the problem, he tended, involuntarily, always to bend the head and trunk slightly forward, whereupon Hans would extend his right foot and begin to tap without putting his foot back after each successive tap. When the desired number of taps was reached, Herr von Osten would, involuntarily, give a slight upward jerk of the head. At this second signal, the horse would retract the foot to its normal position." This completes the story of Kluger Hans, which has been given in some detail because, as we have said, it may be regarded as probably a typical example of the cleverness of which adroitly and patiently trained animals are capable.

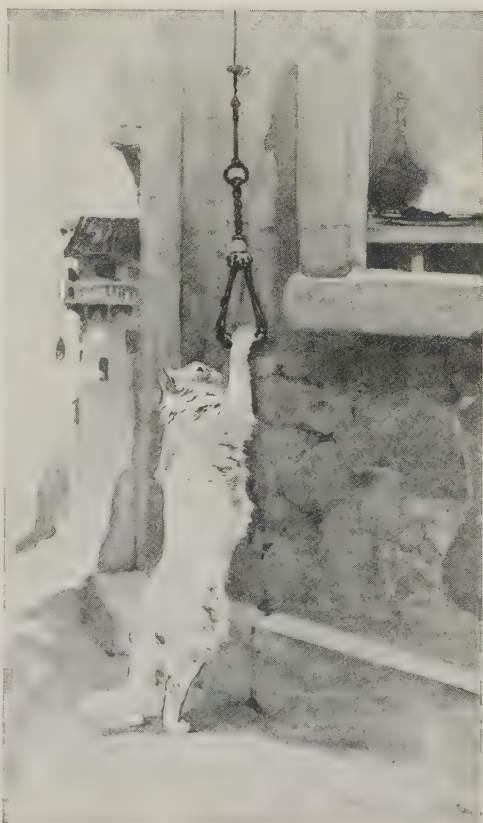
The really noteworthy facts in all such cases are the extraordinary delicacy of perception of which they afford evidence and the sure linking of the perception with some particular mode of behaviour. As I have elsewhere said, those who have seen a shepherd's dog working sheep on a moorland fell, and have taken the trouble to ascertain how the results have been reached, will appreciate, on the one hand, how well the dog responds to the signals of his master, and, on the other, how completely all initiation is due to the shepherd who has trained him. Those who merely witness such a performance without inquiry or investigation will probably misunderstand the whole matter. In the north of England competitions are not uncommon where, say, three sheep have to be driven over a definite course, between certain posts and round others, through narrow passages and into a small pen—the whole within a definite time-limit.

The dog has been trained to respond to some six or eight whistle signals, sometimes accompanied by gestures and movements of a stick. The signals, given in different whistle tones and inflections, have each a particular response in behaviour; on hearing one the dog drives the sheep straight ahead; on hearing others he rounds them from the right or from the left; yet others make

him at once stop, lie down, or creep slowly forwards. The dog's whole business is to obey these signals; and nothing can be more admirable than the instant response of a well-trained animal.

It being now generally admitted that casual observation supplemented by amateurish interpretation is of little or no value, it will be more profitable to give some account of the systematic experiments conducted by trained psychologists, and to indicate some of the more salient conclusions to which, according to experts, they point, than to furnish a *réchauffé* of anecdotes of a type that is already sufficiently familiar. I must assume, however, that readers have sufficient interest in the psychological aspect of the inquiry to be at the pains to grasp what are the problems which trained observers are trying to solve. This will necessitate some further preliminary discussion.

It will be well, first, to devote a short space to a consideration of the manner in which animal skill in effective behaviour is developed. But what does one mean by development? Always, whether we are dealing with animal structure or animal behaviour, one means by development the continuous passage to a further stage of organisation from a foregoing stage of less complete organisation. Now, animal skill is always based on instinctive foundations. There is little doubt but that the flight of a swallow or a seagull is at the outset as truly instinctive as the swimming of a duckling or a waterhen. A bird does not have to learn to fly, or a mammal to run or leap, without any inherited co-ordination of limb movements. The hereditary co-ordination, sometimes more, sometimes less perfect to start with, is the organised foundation on which the far more complete organisation of perfected locomotion is based. Consummate skill is the outcome of continued practice; and through that practice, in the flight of the swallow, for example, the data afforded to the sense of sight, those afforded by the varied pressures of wind currents on the wings, breast, and tail, and those afforded by the execution of the appropriate activities, are all brought into perfect harmony. Those redundant or aberrant movements of the wings or body which conduce to failure and awkwardness are suppressed; only the movements essential to the real business of perfected flight in closest touch with the situation of the moment are retained. Unless we are prepared to regard the organism capable of such wonderful improvement through



A CAT THAT KNEW HOW TO RING A BELL



PHOTOGRAPHS FROM LIFE, SHOWING A CAT USING HER PAW TO GET CREAM FROM A JUG

practice as an unconscious automaton, we must admit that the perfected skill is the outcome of experience, and is therefore every whit as much a mental product as a bodily process. Indeed, such skill development affords an admirable example through which to illustrate the distinction drawn by many psychologists between naïve "experience of" situations with behaviour in appropriate relation to them, and "knowledge about" either the situations or the behaviour. No doubt those of my readers who ride a bicycle have both naïve "experience of" the procedure appropriate to a given situation, and "knowledge about" the principles involved. They know how the principle of inertia is utilised in correcting innumerable incipient tumbles, now to right and now to left. Yet there are many boys of ten who can ride as well as they do, but who neither know nor care to know what principles are involved. I think we may fairly presume that the bird, with its marvellously developed practical experience of all that conduces to effective flying, has no systematic knowledge of mechanical principles. In what, then, does the process of learning consist? In bringing the series of contributory items of experience into line, so that the fitting sequence *a b c d e f*, etc., runs smoothly, and *f*, the swallowing of an insect, duly follows upon *a*, the sight of it in the air. The initial awkward or redundant series might be *a n q b c m p d r e*—the important *f* never being reached owing to failure in skill. The redundancies *n, q, m*, etc., are eliminated, and each part of the business series *a b c*, etc., is improved and linked with its neighbours.

It should be noticed that the development of skill is always in relation to a situation within which the skilled behaviour is appropriate. More, therefore, is involved than the mere motor activity; there is involved also a delicate perception of what is presented to the senses in the surrounding world. Suppose, then, that an animal has learnt a good number of varied modes of behaviour suitable to frequently recurring circumstances in its daily life. Its restless activities are constantly bringing it into new situations resembling, with some difference of detail, those with which it is already familiar. Fresh sequences of experience which may still be symbolised by *a b c d e f*, etc., are again and again

presented. A good deal of experimental work has been directed to the ascertainment of the manner in which such sequences come to be established. There are, however, some questions of interpretation which may here be briefly considered.

It is clear that if the experience of to-day is to be of any value for behaviour to-morrow, there must be some sort of retention of to-day's series, and some sort of revival of that series on the fitting occasion to-morrow. It is clear, too, that the items of experience symbolised by *a, b, c*, etc., must be in some way connected, so as to form a series. Let us take a simple illustration, which may help us to follow up the matter a little further. When I lived at the Cape, I used to take my two dogs on my walks up a spur of Table Mountain. On one occasion, at a certain spot, they put up a coney, or rock-rabbit, and gave chase down a side track. They had the experience *a b c d b e f*, etc., where *b* is the coney. No doubt *b* was continuously present until the coney, unfortunately, at *e* popped out of the range of experience. But we cannot here unduly complicate our alphabetical symbolism. Whenever in the course of a subsequent walk they came to that particular spot *a*, they became excited and raced down the side track. They had, we may presume, the series *a c d e f*. The important item *b*, the rock-rabbit, was not on the scene of action. For more than three years, every time they came to that spot, the series *a c d e f* was repeated. To race down the side track became a settled habit. But what about *b*? We naturally, as amateurs, say that the dogs "remembered" having seen and hunted a coney at this spot. The psychologist must ask just what is to be understood by the word "remember." He urges that it is not in any way necessary to the interpretation of the facts that there should be called up in the mind of the dog a memory picture of the previous occurrence with *b* present, as contrasted with the existing situation with *b* absent. He urges that the primary business of revival, through pre-established connections in experience, is not a backward-looking review of the past, but rather a feeling of present expectancy. To meet the case, many psychologists have adopted the word "meaning" in a rather specialised technical sense. They would say that, after the

first occasion, the spot *a* had for the dog the meaning "rock-rabbit hunt"—just as the sight of its bottle has meaning for the infant. We may term it "expectancy meaning," or, in more technical phrase, "pre-perceptive meaning"—a feeling of what is coming based on the experience of what has on previous occasions been found to come. But a further question here arises. Does the expectancy implied when we say that *a* means *b c*, etc., necessarily involve the formation of a definite image of *b*—that is to say, a mental picture of the cone? The generally accepted view is that it need not revive any definite image.

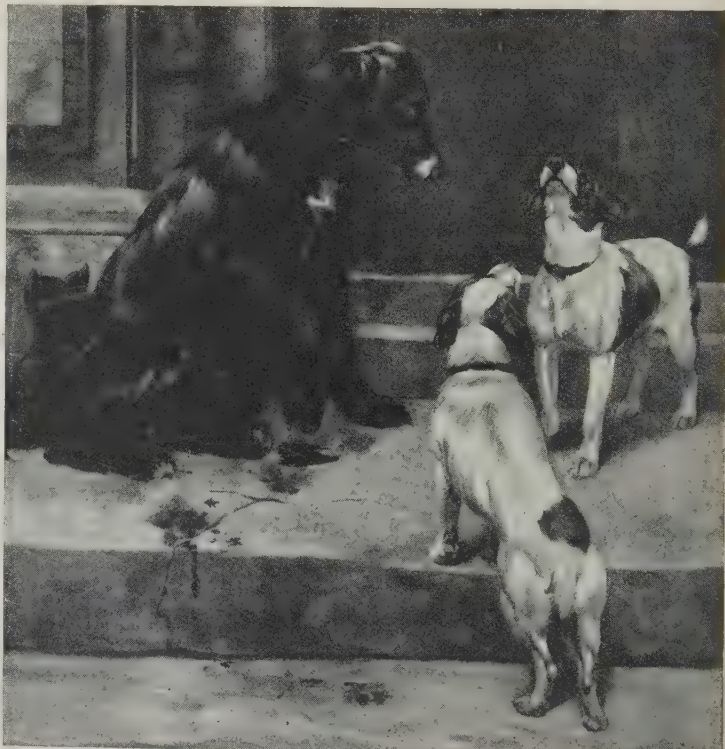
Put the matter to the test of your own experience. Suppose that, while you are writing in your room, you hear a sound in the garden that "means" startled blackbird. Does a definite image of a blackbird arise before the mind's eye? Remember that the question is, not whether you can, but whether you do see it.

For myself, though I visualise freely, I am pretty confident that in ordinary circumstances I do not. Or take another case. I am one of those who are quite incapable of forming definite images of taste. Of course, I know what the taste of coffee is like, and can recognise it when it comes. The sight of my cup of coffee after dinner has pre-perceptive meaning. But I have no anticipatory taste image. Some years ago my cook, by a stupid blunder, sent up some soup, which was being kept hot for my wife, in my coffee-cup. I added sugar and milk, and then had a striking example of erroneous pre-perception. But though I remember that the stuff was exceedingly nasty, I can form no image of its taste on the mental palate in any degree analogous to a visual image or an auditory image. Many people have no visual images, but, none the less, these people have visual expectancy. It is therefore held that there is no necessity, for the satisfactory interpretation of the facts, that there should have been formed in the consciousness of my dog any definite visual image of the rock-rabbit we encountered in our walk. For many of us, no doubt, such images play an important part in retrospective memory—in the picturing of past scenes.

But here another distinction comes into view. There are two kinds of images (revivals of sensory impressions), or, if not two kinds of images, two modes in which they may occur. There is the "anticipatory image," foreshadowing the impression which is just coming; such is the auditory image of the expected report when the flash of a distant gun is seen or the lightning streaks the sky. It is held by many psychologists that this is the form or mode in which images have their genesis, arising out of and being, so to speak, floated off from pre-perceptive meaning. Their value is that they afford more definite and clearcut warning of what is just coming

into our experience. The second form of image, or mode of its occurrence, is the "memory image." The immediately serviceable value has gone; it is more of a luxury. It is not anticipatory, but retrospective, and, when fully developed, carries with it definite retrospective reference to the occasion on which the sensory impression thus revived had its place in vivid experience. One of the much-debated questions in comparative psychology is whether, and if so in what degree, animals are capable of forming definite images, and whether they are anticipatory images or free memory images, or both. It is not easy to devise experiments and observations which shall enable us to give decisive answers; and, as we shall see, different interpretations of the observed facts may be given. Another question is whether animals afford evidence of framing general and abstract ideas. Out of his varied experience of things good to eat, does the dog form an abstract and general idea of "good for eating"? That a number of things that the dog is accustomed to eat carry pre-perceptive meanings which have certain characteristics in common, which are none the less differentiated for his practical experience, and which call forth different modes of behaviour, is likely enough; but has a dog the capacity of attaining to that strange inversion which is a distinctive step towards thought—the topsy-turvydom of fixing attention on the meaning as exemplified by the thing?

Let us consider the manner in which we aid little children to reach the latter point of view. A simple case must suffice. We take a number of objects

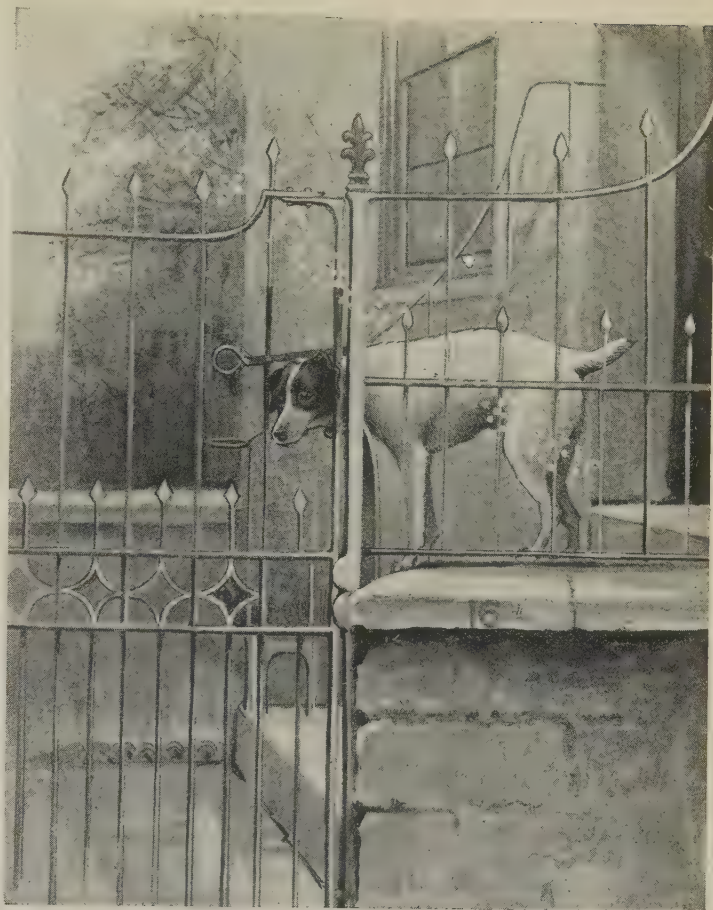


TERRIERS ACCOMPANYING A WOUNDED COLLIE TO A HOSPITAL
From the painting by Y. Carrington at King's College Hospital, by permission of Messrs. A. & F. Pears

which are (*a*) red, yellow, or blue; which are also (*b*) round, square, or triangular; and, further, (*c*) made of paper, wood, or flannel. We get the child to arrange them first in colour groups, then in shape groups, and then in stuff groups. In the first case, colour is that which matters for the purpose in hand; shape and stuff are present to experience, but may, nay, must be neglected. In the second case colour, which before mattered so much, does not matter; shape does. And so on. The child makes a number of mistakes at first, but gradually learns this new game. The fixing of attention on what counts for the end in view, to the temporary neglect of much that is present to experience but does not count, this is the essential feature in the formation of abstract and general ideas. It should be observed that these ideas are not in the least up in the clouds and divorced from the things which the child can see, touch, and handle; on the contrary, their vitality lies in their being embodied in the things; but the objects are now regarded as examples of the embodiment of the idea, and one thing can be freely substituted for another. The round bit of wood can be substituted for the square bit of flannel, if both are examples which embody the idea blue.

When the child has reached a somewhat higher stage of what is termed ideational process—since he regroups experience in terms of ideas—he arranges these ideas in sequence, and searches for objects, facts, and modes of behaviour which shall give to the trains of ideas concrete practical shape. He forms plans of action which shall enable him to reach a wished-for but hitherto unattained end. Here he is at *c*, having passed through *a* and *b*; he badly wants to get to *f*, but how is it to be managed? An ideational plan which he frames in thought, in advance of practical experience in this particular connection, suggests that *d* and *e* afford the appropriate means by which *f* may be reached. He has had, indeed, no previous experience of particular examples of *d* and *e* in this connection; but such examples have, maybe, proved serviceable in another connection. Why not try them here? Perhaps seeing someone else pass through *d* and *e* may suggest the right clue. In any case, he does the thing in idea before he does it in fact, the doing of it in fact being only a translation of the idea into action. As Dr. Stout has well said, it is one of the characteristics of thought-process that you can cross a bridge before you reach it; you can cross it ideally before you traverse it actually.

Much careful experimental work—that is, observation of animal behaviour under controlled conditions—has been carried out with a view to ascertaining how far an animal is capable of supplying the *d e* in the series of actions necessary to reach *f*, and the conditions under which the requisite



A FOX-TERRIER LIFTING THE LATCH OF A GARDEN GATE

series is completed. To a consideration of this experimental work we may now address ourselves.

I have elsewhere described how my fox-terrier learnt to open the iron gate outside my house by lifting the latch with the back of his head. The series, when the trick was established, was: *a b c*, running out of the door and down the steps; *d*, jumping on to a low parapet; *e*, looking out with his head beneath the latch; *f*, running out into the road when the gate had swung open. But in the early stages of behaviour the series was *a b c d m n o d p q d e f*.

In plain English, he jumped up on to the parapet, gazed out through a number of openings between the vertical rails, jumped down again, and up again, looked out elsewhere, and only after some minutes chanced to stumble upon the finally effective sequence *d e f*. There was in this case no evidence of a plan of action of which *d e* was the fitting expression. Only gradually were the useless and redundant activities *m*, *n*, *o*, etc., eliminated, until eventually the effective series in due order of sequence was established. The type of learning was that of trial and error—trial along the lines marked out by normal dog behaviour, error in the sense of failure to get out into the road that way—of the stumbling by chance on the successful behaviour,

and of the gradual linkage of *d*, *e*, *f* by repetition of this behaviour. It may be mentioned that the gate took a little time to swing open by its own weight when the catch was released. Hence, in the early trials, the dog had passed on to look out elsewhere before he saw that the gate was open, and this probably delayed to some extent the linkage of *e* to *f*.

Let us, however, pass to more definitely systematic experimental work. Dr. Small was, I believe, the first to institute an inquiry into the manner in which an animal learns to thread its way through a labyrinth of passages. He experimented with rats, which are suitable subjects, since under natural conditions they grow accustomed to narrow and branching passages. Professor J. B. Watson has carried the investigation a step further. The maze is built on the model of that at Hampton Court, and involves a 40-ft. or 50-ft. run from the entrance to a central chamber in which lies food, and in which the animals have been previously fed.

Two kinds of error are possible: (1) To take a wrong turning which will lead into a cul de sac; or (2) to follow a longer and more roundabout course when a shorter passage is open. It takes a little time—two or three traverses—to establish in the experience of the rat that such a traverse “means” food. In the early trials of the maze all possible errors are made and the time occupied is variable and long. With successive traverses the errors gradually diminish, the right turnings are more often taken, and the times occupied in the complete traverse are progressively shorter, till after, say, thirty runs, the course has been learnt with accuracy, and the times are nearly constant, about two feet being covered per second. For example, the average time in minutes, based on experiments with nineteen rats, in successive trials, here arranged for convenience in groups of three, are as follows:

Trial	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30
Time	10'14	2'31	1'06	1'05	71	52	60	46	42	36

In the first three trials we may surmise that the “meaning” had not yet been well established, and that the animals were timid amid new surroundings. After that, save in the seventh group, there is a fairly regular decrease in the times. From specially devised experiments, Professor Watson is confident that the guiding-sensation cues are those derived from running a certain distance. So much trotting along is the experience *abc*, which is followed by *d*, the appropriate turn to right

or left. There is little or no guidance from sight or smell. In his latest experiments he has used a maze in which the lengths of the runs can be increased or diminished without disturbing the number and sequence of turnings; and he finds that the animals which had learnt the lengthened form of the maze and were then suddenly introduced into the shortened form in nearly all cases ran squarely into the ends of the alleys affected by the change. On the other hand, the animals which had become habituated to the shortened form attempted to round corners at the old distances, regardless of the fact that the alley into which they then should have turned was farther along in the course.

Like observations on the manner in which a maze is learnt have been made on other animals—the dancing-mouse, the guinea-pig, the sparrow, the pigeon—and, with simpler forms of the maze, on the frog, the turtle, the perch, and the crawfish. Dr. Kinaman's results with two monkeys show the same method of learning as in other cases; they, too, attain to about the same rapidity of progress—some two feet per second; but Professor Watson, after comparing these results with those for rats, says that, taking the two sets of records at their face value, the monkey isn't “in it” when it comes to a race in learning the maze. In all cases the method of learning seems to be the same—that of trial and error, with the gradual elimination of the false turns.

A different kind of experiment, first brought into prominence by Professor Thorndike, is that with puzzle boxes. An animal, say, a cat, is placed in a cage, with a tempting piece of fish outside; the door of the cage opens when a latch is lifted, and this may be effected by pulling a string passing along the top of, and inside, the cage, by clawing a button, by pressing a lever, and so forth. In some cases the door was opened by the experimenter (hidden from view) when the cat licked itself or scratched itself. Here, in the terms of our letter formula, the wished-for fish is *f*, the fit and proper series leading up to it *abcde*. Suppose that *a*, *b*, *c* are the initial experiences in terms of perception and behaviour, by what methods are the essential *de* supplied? Observation seems to show that all possible letters of the alphabet—all sorts of scratchings and pullings and tearings—are tried, without any apparent plan of action—based on a scheme of general ideas. As the range of possible modes of procedure is not large, it is natural that *d* should



PERFORMING SEAL BALANCING A LAMP ON ITS NOSE

THE INTELLIGENCE OF ANIMALS

ere long be hit upon by chance; then there follows the gradual linkage of the whole correct series through repetition, and the elimination of random and useless actions. There is no clear evidence of the perception of the relation between the means and the result. The reason why scratching itself should have the effect of opening the door cannot well be obvious to the cat; and yet this is established as the *d* in the series in just the same manner as pulling a string.

In conducting experiments with monkeys it is convenient to place the piece of banana or small bunch of grapes, which functions as *f*, inside the cage. They learn the trick of the fastenings much more rapidly than cats; they can deal with more difficult and more delicate catches, and with combinations of modes of releasing the door-latch, six or seven acts of behaviour having to be carried out in serial order. This is to be expected, first, because the monkey is the more intelligent animal; secondly, because its ability to grasp with the "hand" is a distinct advantage; and, thirdly, because its natural curiosity and its tendency to pick and push at anything which is projecting and loose are well-marked characteristics of its kind.

But unquestionably the learning of the trick of dealing more rapidly and surely with more complex puzzle boxes may be due to the formation in the monkey mind of an ideal plan of action with free memory images, to the thinking of *d e* as the appropriate means of attaining to *f*, and the execution of requisite behaviour, because it is seen to be related to the wished-for end.

Here there is diversity of opinion. Dr. Thorndike sees no evidence to lead him to believe that ideas and free memory images are formed, and Professor Watson has come to the same conclusion. On the other hand, Mr. L. T. Hobhouse is satisfied that such ideas are formed; and Dr. Kinnaman sees evidence of the framing of memory images.



A TRIUMPH OF ANIMAL TRAINING: TWO MONKEYS RIDING BICYCLES
Photograph by Bert, Paris



CONSUL, THE TRAINED CHIMPANZEE, AT BREAKFAST
From a photograph by G. Meggy

It is not clear, however, what kind of evidence would satisfy all parties to the discussion. But there is one question the answer to which may throw definite light on the subject. Do animals supply the *d e* through imitation? We must first be clear as to what we desire to ascertain through experiment and observation. There are two kinds or stages of imitation. There is the natural tendency, shown by many animals, to do what they see others doing, just because they see others doing it and are instinctively provided with follow-my-leader proclivities. Few would be so bold as to doubt the existence of this kind of imitation in the monkey's inherited make-up. There is, secondly, imitation which is subservient to a purpose—the imitation which enables the imitator to insert missing links in the means to the attainment of an end. In the terms of our alphabet scheme, it is the supplying of *d e* because it is seen that *d e* affords just what is wanted to complete a plan of action, though one did not happen oneself, unaided, to think of this particular means of attaining one's object. One would certainly suppose that if a monkey were trying to think of the right means to get a piece of banana that was beyond his reach, the means being at hand, and if, having failed to utilise his opportunities, he saw the means effective in the hands of his master, he would imitate the successful procedure. Mr. Hobhouse reports that this was the case with his monkeys. Professor Watson finds that, with his monkeys, it is not the case. The difference may lie in the monkeys, or in the skill and caution of the observer. I will give a short account of the negative results obtained by Professor Watson, for the most part in his own words.

It should be stated that the monkeys concerned in the following tests were very intelligent, one of them, a rhesus, the quickest animal in learning mechanisms Professor Watson has ever observed. The animal was tethered in an open floor-space; a grape was placed out of reach; a light 10-in. stick with a 2-in. T-piece fastened to one end was left near. In order to get the grape the monkey would have to hook the T-piece behind the grape and pull it in. Three monkeys were given several hundred trials; never once was the slightest effort made to use the rake in the right way. Then Professor Watson tried to show them how to draw in the food. He would wait patiently until he apparently had their attention, and then slowly hook the T-piece round the grape and slowly draw in the food till the monkey could grab it. Though this was often done, never once did any of the animals subsequently push out the rake, hook the blade round the grape, and then pull it in. Again, a piece of banana was placed in the bottom of a tall bottle, and a sharpened stick was stuck into it. The animals on their first trial immediately grasped the stick and jerked out the banana. The experiment was then repeated, but the stick was not stuck into the banana. The monkeys, as before, jerked out the stick, threw it down, and tried to reach the food with the paw. Professor Watson tried to teach them the use of the stick, but failed signally. Yet again, the animal had to push a piece of banana from the middle of a 15-in. glass cylinder fastened to a table. A light 16-in. stick was placed near. The monkeys clawed and bit at the cylinder near the banana; they then tried to reach the food from one end with the paw. Day by day Professor Watson took the light stick, put it into the cylinder, and then slowly forced the banana out. The monkeys watched its passage and grabbed it when it came out at the end of the cylinder. They did not use the stick themselves. Meeting no success with this procedure, he put the stick inside the cylinder just in contact with the food; the monkey would simply have to push the food out. Invariably, after oft-repeated lessons, the monkey

first jerked out the stick and then began its efforts to extract the food by means of its paw.

Professor Watson tells us that the anecdotal material he has collected while observing his monkeys would compare favourably with that presented by Romanes and others; but he says that close examination of such acts, especially during the period of their genesis, does not lead him to think that the higher forms of imitation are present, or that the monkeys ever resort to learning by the perception of the relation between means employed and results attained. But he wishes it to be understood that his present conviction stands ready to be changed as soon as the evidence calls for it. Such is a sample, and, of course, it is only a sample, of the kind of experimental work which is being carried out.

Although the evidence is, to my mind, not quite convincing, it is not improbable that we shall learn that animals have at least the earlier and simpler forms of ideas, and shall learn, too, more of the nature of these ideas and the manner in which they are used. When the research has been carried somewhat further, we shall need to correlate its results with the more open-air results of such observations as were so admirably recorded by Le Roy. Meanwhile, we must keep an open mind, duly cautious and critical, but wholly without prejudice. If language is the chief tool of thought, we cannot expect, on general grounds, the animal to get far without the free use of the potent symbolism of words. The facts, as they seem to be gradually shaping, are what the evolutionist might well anticipate. After all, the trial and error method, though it may seem to us rather hopelessly haphazard, is likely to be successful in at least 99 cases out of 100 in the natural life of the animal. One thing, at any rate, comes out with increasing clearness—that the perceptions of the higher animals are wonderfully delicate and keen, probably in their own fields as keen as, or keener than, our own, and that these dumb brutes are marvellously quick—perhaps as quick as, or even quicker than, most of us—to profit by experience.

C. LLOYD MORGAN



THE PATHOS OF THE WILD: A YOUNG ELEPHANT FINDING THE DEAD BODY OF HER MOTHER AND TRYING TO ROUSE HER



By

THE CHAMÆLEON

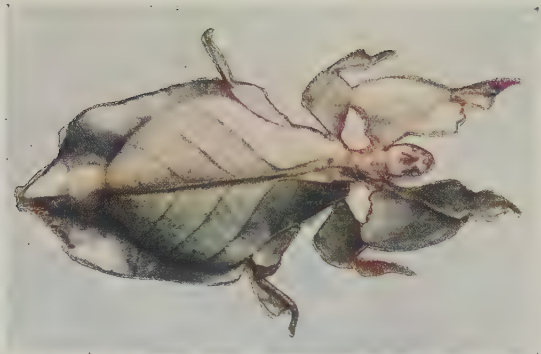
A species of lizard which possesses the power of "rapidly adjusting its colours to those of any of its normal environments.

Prof. Poulton





The inoffensive wasp and hornet
the stinging insects after



A humble bee and two bee-hawk moths, which bear a close
enough resemblance to the first to be mistaken for it



The Canadian peacock moth has its under-wings marked with
two owl-like eyes, which frighten birds away



What a beautiful thing to see a butterfly on a leaf of the same color



The katydid is a very common insect in the garden and is often found on the leaves of the plants



The female (left) of the black *Hypolimna misippus* mimics
colours of the nasty-tasting *Limnas chrysippus* (right)



NATURE'S PROTECTIVE MIMICRY IN THE INSECT WORLD

Reproduced by direct colour photography from the actual insects by F. Martin Duncan



LION AND LIONESS SIGHTING PREY IN THE DISTANCE

These denizens of the open desert "are often nearly devoid of markings, being sufficiently concealed by their obliteratively shaded colour." *Prof. Poulton*

THE CONCEALING COLOURS OF ANIMALS

NATURE'S STRANGE DISGUISES FOR PROTECTION AND AGGRESSION

By EDWARD B. POULTON, F.R.S.

Hope Professor of Zoology in Oxford University

THE fact that animals are commonly well concealed in their natural surroundings must have been known to the primitive hunter, taught by the difficulties of his craft. The amount as well as the perfection of this concealment is liable to be greatly under-estimated by those who are chiefly familiar with animals in captivity, with specimens in museums, or illustrations in books.

An animal may be concealed by its likeness to a particular object, such as a leaf or twig, the lichen on the bark of a tree, a stone, or a lump of earth. It may also be hidden by such a general likeness to its surroundings that it becomes more or less invisible. Form is of great importance in the first kind of resemblance; of less importance, and sometimes of no importance, in the second; thus, the concealment of a stick-like caterpillar or a leaf-like butterfly is largely brought about by form, while, on the other hand, the shape of a transparent bluish jellyfish, floating on the surface of the ocean, is of little importance for the purpose we are considering.

Looking at the earth as a whole, we find two principal classes of surface from the point of view of the concealment of living forms. There are, first, the uniform expanses of the deserts and the sea at a distance from the shore; and there are, secondly, the expanses of land diversified by the myriad forms of plant life, and the coast lines and neighbouring shallow waters diversified by animal and vegetable growths of the most varied kinds. It is common for animals in these latter parts of the earth's surface to exhibit detailed resemblances to particular objects, while the general resemblances are more characteristic of the uniform areas.

The separation between the two classes of surface is not by any means complete; for example, parts of the ocean remote from land are permanently covered with floating seaweed, while in close proximity to diversified surfaces of land or shallow water are the broad stretches of uniform sand. Furthermore, large tracts of Africa are desert-like during the dry season, but support an abundant and varied vegetation during the wet. So also the distinction between the two kinds of resemblance is not sharply marked; for both are often to be found on the same animal. Thus, its general background of colouring may resemble a surface of earth or sand, while its markings convey the effect of particular objects, such as dead leaves or stems, found upon that surface (see, however, page 112). Again, the stones that are commonly scattered over the desert areas of the earth's surface may be resembled in shape as well as colour.

Thus certain plants of the Karroo, and other parts of Africa which are desert during the dry season, present the most beautiful and detailed likeness to stones (see figure on page 110), and the same is true of certain grasshoppers (Acridians). This observation was made in 1812 by W. J. Burchell.

It must be remembered that there are also general resemblances, not only to uniform areas and the surfaces of the diversified parts of the earth, but also to particular objects. This will be made clear by an illustration. When we are shown a stick-like caterpillar or a leaf-like butterfly, the meaning of the form and colouring is clear and the concealment obvious. When, however, we look at the large caterpillar (figure, page 111) of the Privet-hawk moth apart from its surroundings, we find it difficult to realise that such a large green object, with its distinct oblique white stripes bordered with purple, can be anything but highly conspicuous among the leaves of the privet or lilac on which it is most commonly found. But, as a matter of fact, the caterpillar is well concealed on these plants, and it is often a task of some difficulty for even an experienced naturalist to find an individual whose presence is indicated by freshly eaten leaves.

There is little doubt that the purple-margined white stripes add greatly to the resemblance by breaking up the green surface of the large caterpillar, and perhaps by giving the effect of leaf-shadows tinged with complementary colours. It is to be noted that the purple margins do not appear while the caterpillar is in its younger stages and comparatively small, and that they become a marked feature only in the last stage. There is, further, strong evidence that this caterpillar is specialised for concealment, inasmuch as it possesses the power of developing a different and appropriate shade of green, according as its food-plant is privet or lilac.

I have fed Privet-hawk caterpillars, hatched from eggs laid by the same moth, on these two bushes, and found that those on the privet became a brighter, yellower green than those on the lilac. The same difference is also to be found in the wild state. The concealment of the Privet-hawk caterpillar—which is an undoubted fact, however difficult it may be to realise it apart from the surroundings—is a general resemblance to leaves, while that of a leaf butterfly (such as *Kallima*; figure, page 111) is a special resemblance. The one produces the effect by colour almost unaided; in the other the resemblance in shape is as perfect as are the details of the markings.

It has been necessary to introduce in the preceding paragraph an example from the insect world instead

of considering it in its place on a later page, in order to illustrate a class of resemblances which is probably very large, but as yet imperfectly appreciated and understood. The concealment brought about by general protective resemblance can only be appreciated by the study of living Nature, and can only be completely understood by the insight of the artist. The principle itself was brought forward by the present writer in a paper which was read before the Entomological Society of London on November 7, 1883, and published in the "Transactions" of that body in 1884 (pages 48-50); and it was afterwards analysed and advanced in a remarkable way by the discoveries and interpretations of the great American artist-naturalist, Abbott H. Thayer. These have grown out of the important fundamental discovery which I now proceed to describe.

We are here considering a general principle of colouring, which holds more or less extensively throughout all the animal groups that depend on concealment. The white under sides of animals were formerly explained on the same principle as the white colour so commonly observed in birds' eggs laid in concealed nests, or the pale tints of subterranean forms, or those found in caverns. In all these cases it was assumed that the colour, being useless and no longer sustained by natural selection, had disappeared, or was on the way towards disappearance. Mr. Thayer, however, showed in 1896 that the gradation usually seen in animals, from dark on the back, through increasing paleness on the

sides, into white underneath, is of the utmost value in promoting concealment, and bears the evident stamp of adaptation. He showed that the colouring is brightened so as exactly to compensate for the gradually decreasing illumination of the animal's body at lower and lower levels. The back, which is darkest of all, is exposed to the full illumination of the open sky, the sides, becoming lighter and lighter, are illuminated less and less, finally passing into the white of the belly, where the illumination is least. And the gradation in tint is accurately adjusted to the varying degree of illumination from the normal source. The remarkable degree of accuracy may be inferred from the fact that Mr. Thayer's models were painted by him for the special illumination of the position where they may now be seen, in the Natural History museums of London, Oxford (figure, page 112), and Cambridge.

The wonderful effect which he has produced could only have been obtained in this way, and the balance between illumination and depth of colour is so delicate that it is only at its best at the time of the year when Mr. Thayer did his work, and is disturbed by the fine film of dust which gradually collects on the surface of the models. The appearance of solidity and relief is conferred by shadow, and the neutralisation of shadow on the surface of animals and of Mr. Thayer's models removes this appearance, and produces a ghost-like, translucent effect. When to the neutralisation of shadow is added a colour which harmonises with the surroundings, the animal seems to melt into and become one with its background. Natural selection, operating upon variations which tend in the direction of concealment, has produced what all artists in all ages have, until now, failed to discover.

The artist, by *painting in* the shadow, can give objects on the flat surface of his canvas the

most convincing appearance of relief; but until Mr. Thayer's discovery he never realised that by *painting out* the shadows of a solid object he can destroy the appearance of relief and solidity. I once asked Mr. Thayer how it was that he found what so many have missed. He replied that he found it in Nature. He observed that wild animals in their natural surroundings were ghostlike and inconspicuous — so much so indeed that in order to render them clear and distinct on the canvas it was necessary to paint them silhouetted against the light on the sky-line, or else as they would appear in an unnatural

illumination. He was led by observation to examine their colours carefully, and thus discovered the principle of the neutralisation of shadow, which he then confirmed by painting models so that they became well-nigh invisible, or, in the most favourable circumstances, entirely invisible.

The colour harmony between such an animal as the hare and its background is produced in the following manner. The dark, earth-coloured back, bathed in the cold blue-white of the sky, resembles the earth, which is, of course, itself equally illuminated from the same source; and a similarly close resemblance to the ground is presented by the cold blue-white of the belly steeped in shadow and yellow earth reflections. Passing from the back towards the belly the illumination becomes less and less, and the colours correspondingly brighter. In fact, the animal appears to possess a uniform earth colour owing to the fact that its colours are not uniform, but always related



PLANTS THAT RESEMBLE STONES

This plant, *Mesembryanthemum bolusii*, grows in the African Karroo, and resembles the stones around it. From an illustration by Sir W. Thiselton-Dyer

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to the amount of light received from the open sky. Mr. Thayer has painted models (placed beside those I have mentioned, as shown in the figure on page 112) and the feathers of stuffed birds so that they are of a uniform depth of colour, and these appear to be darker and darker as the illumination decreases in passing from the back to the belly. Such a specimen is cut off from the ground and rendered prominent by a deep black shadow.

The principle of shadow neutralisation was recognised by the present writer in 1887 and 1888, but its far-reaching importance was not grasped until Mr. Thayer published his great discovery in 1896. The earlier examples are of interest, for they show the same principle of concealment at work among insects. The first was a stick-like caterpillar (allied to the one figured on this page), which holds on to the branch by its two posterior pairs of claspers and stands out like a side twig.

The body of the caterpillar between the last pair of claspers and the last but one is cut off from the branch by a distinct groove or chink, and here the shadow would show that the two objects are really different and not continuous, were it not for the neutralising effect of a bright colouring. The principle is the same as that by which there is elimination of shadow in the chink between the earth and the rounded body of a mammal or bird. The second instance was the green chrysalis of the Purple Emperor butterfly (figure, page 112), which, in spite of its thickness, closely resembles one of the flat leaves of the willow on which the caterpillar feeds. The appearance of flatness was shown to be produced by a white stippling, which neutralised the shadow that would have betrayed the rounded surface, and hence the thickness. The amount of stippling was adjusted to the steepness of the slope. "By this beautiful and simple method a pupa, which is 8.5 mm. from side to side in its thickest part, appears flat, and offers the most remarkable resemblance to a leaf which is a small fraction of 1 mm. in thickness."

A complete and detailed account of Mr. Abbott H. Thayer's discoveries has been published in a

finely printed and illustrated work by his son, Mr. Gerald H. Thayer, under the title of "Concealing Coloration in the Animal Kingdom: An Exposition of the Laws of Disguise through

Colour and Pattern." In this volume there are embodied the facts and conclusions of all Mr. A. H. Thayer's papers dealing with the subject, as well as a large amount of new matter and great numbers of novel and very beautiful illustrations. Some of these—to be mentioned in the later pages of this article—illustrate ideas which naturalists will probably consider erroneous; but nothing in the work ought to be allowed to diminish or obscure the importance of the great fundamental discovery of the neutralisation of shadow and its significance. This must stand for all time as a landmark in the progress of investigation into the colours of animals.

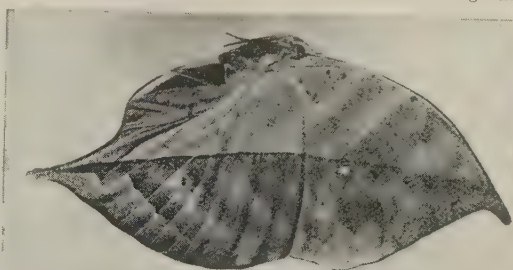
After showing that *light and shade* on solid objects are the means by which "the eye is made aware of their *existence*, their *main form*, their *position*, and all their *minor modellings*," the author points out "the fallacy of the statement . . . that a protectively coloured

animal of the type described above escapes attention because, being of a dull-brown colour like the ground and the bushes, it looks when it sits motionless like a clod or a stump—or some such inanimate thing. For clods and stumps are solid objects of a uniform tint, and manifest to the eye, by the laws of light and shade, not only their solidity, but all their smaller modellings. They are not inconspicuous, except in so far as their great abundance makes the eye inattentive to individual ones. The protectively coloured animal, on the other hand, is, as it were, *obliterated* by his counter-gradation of shades, and in the cases where he escapes notice, it is by virtue, not of the eye's perceiving his solid form, and taking it for that of an inanimate object, but

of its failure to recognise it as a solid object of any kind, seeming, if it rests on it at all, to see *through it to what is beyond*" (Thayer: page 19). The effect produced by Mr. A. H. Thayer's models is of this kind—if the eye rests on them at all it



A CATERPILLAR THAT RESEMBLES A TWIG
The caterpillar of the waved unburner moth clings to a stem with its hind claspers and stands out like a twig



THE DRY-SEASON KALLIMA, OR LEAF BUTTERFLY
The figure shows a hanging position. In wet-season specimens the bent leaf-tip is barely represented



THE PRIVET-HAWK MOTH CATERPILLAR
The purple-edged white stripes of the caterpillar help to make it inconspicuous among the privet leaves

seems to see through them. The soundness of these conclusions may be demonstrated, as the author suggests, by holding an obliteratively shaded creature "upside down, in its normal lighting, and against its normal background. It will be seen not merely that its ghostly dimness has vanished, but that it is extraordinarily conspicuous—just doubly as conspicuous, in fact, as any stick or clod placed in the same position would be. For an inverted animal not only lacks counter-shading, as a stick or clod does, but is even fully shaded the *wrong* way—brightest where it catches most light, and darkest where it catches least. No other conceivable arrangement of colours could make an object as conspicuous as this. Yet an animal held thus inverted is, materially, as truly 'coloured like his surroundings' as he ever was" (Thayer: page 20).

Other convincing evidence that obliterative shading is by far the most important element is offered in the same work. Thus Mr. Thayer reproduces (in his figure 6) a photograph of the Plymouth Rock hen posed against a background of skins of the same breed. In this fowl, as in so many

artificially selected races, the natural obliterative shading has been lost, and the hen stands out conspicuously in spite of a pattern which is, of course, precisely the same as that of its background. The markings on an obliteratively shaded animal are "not an exact reproduction of the actual background pattern, but a picture of that pattern as it looks when more or less altered and refined by distance." The animal "must bear a picture of such background as would be seen through it if it were transparent" (Thayer: page 31). This picture, Mr. Thayer maintains, is made up of a smaller pattern on the higher parts of the animal, which are seen from the side against a more distant background. The dorsal pattern looked down upon from above is coarse, to match the details of the ground below, which are only reduced by a distance equal to the height of the animal's back.

The following passage describes these concealing markings on the obliteratively shaded body of an animal as Mr. Thayer sees them: "Only an artist, perhaps, can rightly appreciate the profound and perfect realism of these background pictures worn by birds and other animals. Just as a good caricature drawing of a man looks in one sense more like the

man than the man himself, so, in a far more high and wonderful degree, do these pictures on animals' coats exceed the verisimilitude of the actual scenes they imitate. They have been compounded and epitomised and clarified till only pure, essential typicality remains. . . . Just as in great human art, but far more essentially and surely, the trivialities and chance individual abnormalities have been eliminated, or subordinated to the scheme of ultimate,

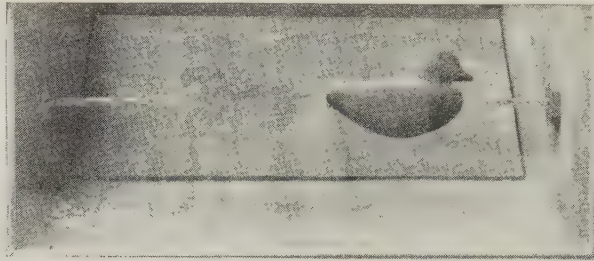
impartial typicality. To learn, then, the purely characteristic colours and light-and-shade effects of leaves and sticks and stones and other parts and types of natural scenery, we should look not at the scenes themselves, but at the animals whose patterns picture them. The essential realism of these pictures is such as the keenest artist

among men could never hope to match. Nay, for Nature herself [The words "Nature herself" are intended by the author and his father to express "natural selection, pure and simple and omnipotent"] has made them—Nature herself has discovered and applied, to a point utterly beyond human emulation, the art of painting pictures" (Thayer: pages 39, 40). The naturalist who, not being also an artist,

is therefore unable to see all this in the concealing colours of animals, would naturally wish to learn from the man who has thrown so much new light upon the whole subject; and the naturalist would probably be right in accepting the above conclusions, at any rate in large part. It cannot be doubted, however, that his faith is likely to be severely shaken by some of Mr. Thayer's illustrations, to be considered in later pages, and that a scientific instinct would rightly make him very suspicious of backgrounds like that of the wood duck in Mr. Thayer's plate 3, which was "copied, colour-note for colour-note, from the bird himself."

The "Obliterative Colouring" of A. H. Thayer, of which a brief account has been given above, is a further and far higher development of the principle of "General

Protective Resemblance," which I briefly described and illustrated in 1883. The immense advance is, of course, due to the discovery, in 1896, of the great and far-reaching law of obliterative shading. Mr. Thayer uses the term *mimicry* to express what I called *special protective resemblance*, and he discriminates between *mimicry* and *obliterative coloration* just as I discriminated between *special* and *general protective resemblance*, always allowing, however, for



MR. THAYER'S MODEL IN THE OXFORD MUSEUM

The lefthand duck, being counter-shaded, is almost invisible; the righthand duck, coloured uniformly like its background, is made conspicuous by shadow



CHRYSALIS OF THE PURPLE EMPEROR

The chrysalis, as it hangs by its tail, gives the appearance of a leaf in form and thickness, though it is much thicker than one. Photo by A. E. Tonge

THE CONCEALING COLOURS OF ANIMALS

his classical discovery of shadow obliteration. The parallelism between our lines of thought may be judged by comparing the following passage from page 25 of Mr. Thayer's book with the words on page 109 of the present article: "Protective or disguising coloration, then, as we define it, falls into two main divisions; the one including *concealing* colours mainly based on counter-shading, and the other including *mimicry*, in almost all its branches. As has already been explained, the goal of the former principle is the rendering animals *invisible* in their normal haunts. [Compare also the description of the concealment of the Privet-hawk caterpillar, on page 109, with Mr. Thayer's words on page 36 of his book on the patterns of the forest *Caprimulgidae* (Goatsuckers): "The fact that none of these detail-picturings is so patently realistic as to be appreciable to everyone when the bird is seen away from its natural environment is part of the very marvel of the thing."] Mimicry, on the other hand, aims at *deceptive visibility*; it makes an animal *look like something else than what it really is*. It will be seen that the latter principle is open to unlimited variations of method and result, whereas the former, as we have proved, is in its main essentials strictly limited. There are innumerable kinds of solid objects for animals to simulate in appearance, but there is only *one* way to make a solid object in a natural lighting cease to appear to exist. Both these are principles of disguising costume, and both are protective, yet they are fundamentally unlike. . . . We have, then, *obliterative coloration* and *mimicry* as the two main principles of 'protective coloration.' The same ideas were expressed in the description of the ruffed grouse, beautifully represented in its forest environment in Thayer's plate 2:

"Nature has, as it were, used the bird's visually unsubstantialised body as a canvas on which to paint a forest vista. In this there is nothing of mimicry, as we define it. Mimicry uses the solid aspect of an animal's body, modified in form and colour, to simulate some other solid object. But vista- or background-picturing, based on the complete obliteration of the animal's solid aspect, which causes its actual form to pass for an *empty* space, is a widely different principle."

It is certainly true that the word "mimicry" was originally used in Mr. Thayer's sense by H. W. Bates to include the above resemblances as well as the deceptive likeness of one animal form to another. It is, nevertheless, a very inconvenient practice to employ the same term for the resemblance of a

caterpillar to a stick and of a moth to a wasp. Concealment, pure and simple, is the object of the one; the suggestion of efficient defence is the object of the other. Although deprecating the use of "*Mimicry*" for this purpose, I recognise the desirability of possessing new terms to express more precisely the differences which I formerly discriminated by the use of (1) *Special* and (2) *General Protective Resemblance*; and I suggest that "*Imitative*" (with "*Imitation*") should be employed for the first, and Mr. Thayer's "*Obliterative*" (with "*Obliteration*") for the second. The more accurate technical term "*Eikonic*" (with "*Eikon*") may be employed as alternative to "*Imitative*," and "*Aphanistic*" (with "*Aphaneia*") as alternative to "*Obliterative*."

Adjustable protective resemblance is the highest and most complex of all the methods by

which concealment is attained. An animal which possesses this power can adjust its colours to those of any of its normal environments. The adjustment may be *rapid*, in forms which are apt to wander from one environment to another, such as fish (figure, page 119), frogs, the chamæleon, certain crustacea, and cuttlefish.

Probably this rapid adjustment is always initiated by the influence of reflected light upon the eye and a resulting nervous impulse conveyed by the optic nerve to the brain. Thus stimulated, the brain-centre discharges impulses by the outgoing nervous paths to the pigment-cells, whose partial or complete contraction or expansion determines the colour. *Slow adjustable protective resemblance* is found, on the other hand, in comparatively sedentary forms passing their lives in a single environment, which, however, is only one out of many

different environments, any other of which might have been prearranged for the individual. Thus, the Peppered moth (*Amphidasys betularia*) lays its eggs on trees or bushes with twigs which may be dark brown, light brown, green, or whitish; the Lappet moth (*Gastropacha quercifolia*) may lay them



A FLOWER-LIKE MANTIS

We have here an example of aggressive coloration, other insects being attracted to the flower-like mantis and so caught



THE COTTON-TAIL RABBIT

An example of protective coloration among mammals
Photograph by H. C. White Co.

on old lichen-covered hedges or on hawthorn of younger growth. In all such cases the power of adjustment is of the utmost importance; but it only requires to be exercised once or twice—and generally once only—in a lifetime. So far as the subject has been investigated, it appears that slow adjustment is effected through the stimulus of light upon nerves of the skin, and not upon the eye.

Adjustable oblitative shading is better considered under the reptiles (page 117), for up to the present this principle has been observed in no other class.

Changes corresponding with the summer and winter are well known in northern mammals and birds, etc., and corresponding with the wet and dry seasons in tropical butterflies. These will be more usefully dealt with in detail later.

A plausible interpretation of animal colouring is well refuted by Mr. Thayer: "This indisputable fact, that animals tend to be *dark* in thickets and dusky forests, and *pale* on the glaring desert and on ocean beaches, is a complete refutation of the theory that the counter-shading is due to the *tanning* effect of light. On the other hand, the idea that the paleness of desert creatures is due to *bleaching* is equally well answered by the fact that their *shadowed under sides* are still the lightest, as in the case of almost all other animals" (Thayer: pages 27, 28).

Either kind of concealing coloration—oblitative or imitative—may be employed for the purpose of seizing prey or defence from enemies. Anticryptic, or aggressive, resemblances for the purpose of attack may thus be divided into (a) Aggressive Oblitative Coloration, and (b) Aggressive Imitative Resemblance. The far more abundant examples of procryptic, or protective, resemblance may be similarly classified as (a) Protective Oblitative Coloration, and (b) Protective Imitative Resemblance. (The corresponding technical terms would be Antaphanistic, Anteikonic, Proaphanistic, and Proeikonic.)

CRYPTIC RESEMBLANCES IN THE MAMMALIA

Oblitative coloration is by far the commonest mode of concealment in mammals, and it is often employed for the purpose of attack as well as defence. The great majority of quadrupeds are, as Mr. Thayer states, "darkest on the back and lightest on the belly, usually with connecting intermediate shades. *White* is by far the commonest colour for the middles of their under sides, while the dark of the upper sides very often culminates in a black or dusky median line, a sort of painted 'ridge pole,' laid along the centre of the back, over the

tips of the dorsal vertebræ. With or without such extreme accentuation, complete oblitative shading characterises most of the species of almost all the mammalian orders" (Thayer: page 119).

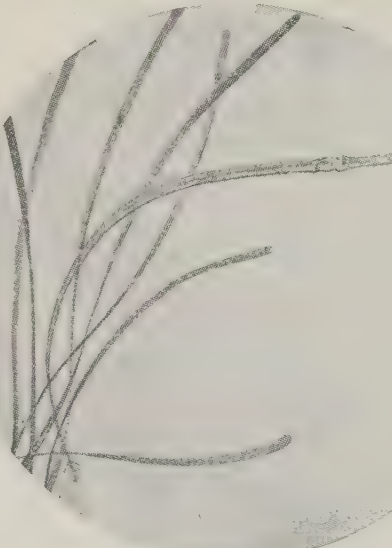
A good example of protective obliteration is represented in the cotton-tail rabbit (figure, page 113), while aggressive obliteration is illustrated by the jaguar. Mr. Thayer justly claims concerning the former, as well as certain other coloured illustrations of his work: "These paintings of ours . . . are, we believe, the first ever published which rightly illustrate and in some respects do justice to the wonderful effects of oblitative coloration, based on the great law of *oblitative shading* . . . The world has had enough, or must soon have had enough, of pictures of birds and beasts with their light and shade falsified to make them show. Outdoor Nature as it really is, in the matter of marvellous and exquisite visual correlations between animal and environment, offers to art, in this late age, an almost boundless virgin field" (Thayer: pages 127-8).

The value of oblitative colouring in the normal position of a mammal is well seen by placing an animal such as a hare on its back, so that the effect of its colour gradation is reversed.

Looking at the Mammalia as a whole, the absence of bright colour is remarkable; and when it is seen, as in certain monkeys, its seat is the skin, and not the hair. Strong contrasts of dark and light are, on the other hand, well known, and may be strongly oblitative, as in the zebras, and probably so on the legs of the okapi. Mr. Thayer truly points out that mammals of the open

country, such as lions (see page 108) and many species of hares, are often nearly devoid of markings, being sufficiently concealed by their oblensively shaded colour. In the concealment of forest forms, on the other hand, pattern plays a very important part. Darwin did not accept the usually received interpretation of the markings of the tiger as an aid to concealment, believing that they were first developed in the male by sexual selection, and later inherited by both sexes. In this case Darwin's wonderful scientific judgment was probably at fault, for it is far more likely that the pattern is an aggressive resemblance to vistas of upright stems and their shadows. But, as Mr. Thayer points out, even the tiger's inconspicuousness is primarily due to oblitative shading, and only secondarily to the pattern.

Imitative resemblance is very scarce in mammals as compared with obliteration, and when present is usually observed in arboreal forms. It is said that the manis, or pangolin, clings to a trunk with the



THE ENGLISH PIPE FISH

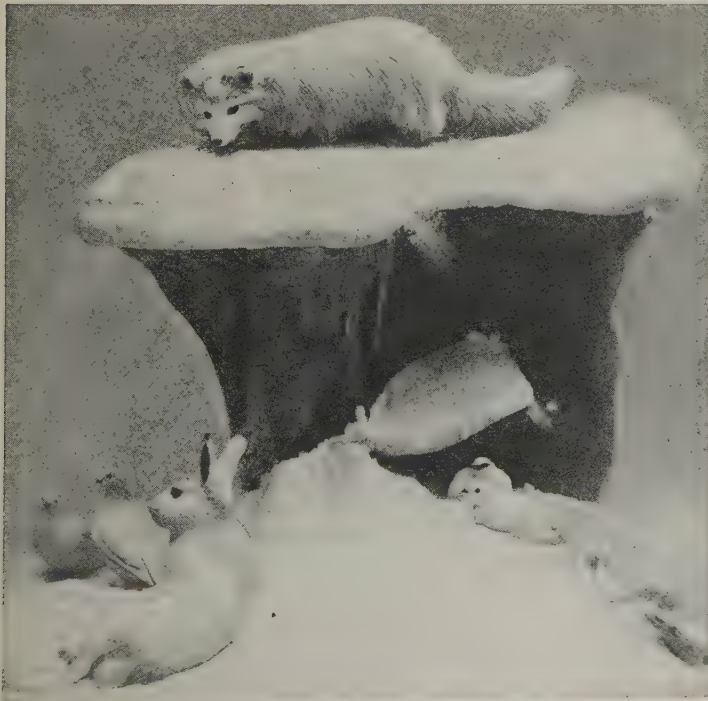
This fish resembles the green strap-like leaves of the zostera. Painted from life in the Plymouth Laboratory by Mr. H. M. J. Underhill

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anterior part of its body standing out like a broken branch. Some bats also resemble the roughnesses of bark, while sloths look like masses of a vegetable nature. Sloths are sometimes green, owing to the presence in their hair of an alga—perhaps the food of the larvæ of small moths which breed in the fur of these remarkable animals.

The seasonal changes of Arctic mammals have been insufficiently studied. Some species appear to become white by a moult, which still occurs when the individual is removed to a more southern land with a mild climate. In other species there is some evidence of changes in the hair caused by the stimulus of cold. It is quite likely that the change is produced in more than one way; but the whole subject requires careful experimental investigation.

The artificial production of low temperatures is now so easy that there should be no difficulty in conducting a long series of well-considered experiments on this interesting and important subject. It is to be observed that seasonal whitening in the north is aggressive (as in the Arctic fox and ermine), no less than protective (as in the Alpine hare and lemming). Obliterative shading is impossible in northern and Alpine forms which match the snow; for, their backs being white, no lighter shade is possible on any other part of their bodies. "But," as Mr. Thayer states, "the upward reflection from the snow itself goes far towards concealing the shadow on such animals."



ARCTIC AND ALPINE ANIMALS IN THEIR WINTER COATS

During the snow season the Arctic fox, Alpine hare, and ptarmigan adapt their coats to the pure white of their environment. Natural History Museum, South Kensington



ARCTIC AND ALPINE ANIMALS IN THEIR SUMMER COATS

In the summer the Arctic fox, the Alpine hare, and the ptarmigan, shown here, are coloured like the heather and rocks among which they live. Natural History Museum, South Kensington

Mr. H. Lyster Jameson obtained evidence in 1895 that the great majority of individuals of the common house mouse living wild on the sand-hills of North Bull, Dublin Bay, are more or less pale and sand-coloured. Only five specimens out of thirty-six were as dark as the ordinary mouse. North Bull is, at the

lowest tides, separated from the shore by a strip of water 20 yards wide, which, however, is crossed by a bridge. Mr. Jameson suggests the reasonable hypothesis that the local change of colour has been due to selection by hawks and owls, which may often be seen hunting for prey on the island. These birds, guided by sight, would most readily capture the darker individuals. The North Bull is a formation of recent date, and Mr. Jameson's study of ancient maps allows "about 100 years for the evolution of the pale race, with a maximum limit of 120 years."

Before concluding the mammalia, it is necessary to say a few words about the part played by stripes and patches of white or pale colour. Mr. Thayer calls these "secant" and "ruptive" markings respectively, because he believes that their function is to "cut up" or "break up" the pattern, so that, for example, the silhouette of a dark animal against the sky loses its revealing form, and is cut or broken up by the light markings into irregular dark masses. Although this interpretation is no doubt often correct, Mr. Thayer adopts it for slow-moving, specially defended mammals, such as the skunk, whose markings, whatever secondary significance they may possess, primarily serve to warn their enemies.

CRYPTIC RESEMBLANCES IN BIRDS

Mr. Thayer gives a far more complete account of obliteratively shaded birds than of any other group of animals. He classifies the examples under the following heads, according to the character of the background picturing which he recognises upon the obliteratively shaded body: (1) a picturing of the larger details of the nearer ground, as in snipes and woodcocks (not including the European woodcock); (2) an intensely elaborate picturing of the minute details of the near ground, as in forest goatsuckers; (3) a picturing of the more distant background, as in certain forest grouse, owls, and the European woodcock; (4) grass and heather patterns, as in sparrows, larks, pipits, quails, ptarmigans, and many other birds; (5) bark and forest vista picturing of climbing birds, such as woodpeckers, wrynecks, nuthatches, and creepers; (6) beach-sand and pebble patterns of shore birds; (7) reed picturing of bitterns and certain herons; (8) water markings and colours of certain aquatic and swamp-haunting birds, such as duck, teal, etc.; (9) the coloration of ocean birds.

To each of these types of colouring Mr. Thayer and his father have devoted much careful observation. The illustrations are numerous and very beautiful, the Rocky Mountain white-tailed ptarmigan on its nest (Thayer: Fig. 41) being the finest photograph of a bird I have ever seen. This magnificent representation of the obliterative effect of grass picturing was obtained by Mr. Evan Lewis. I do not doubt that Mr. Thayer's conclusions are, as a whole, correct, and that he has given us by far the best introduction to



THE COMMON WILD DUCK ON ITS NEST

In colour and markings the bird resembles the undergrowth in which it has its habitat. Photo by W. Bickerton

the study of the cryptic colouring of birds. The creation of a background out of the bird's own pattern has already been criticised (see page 112), and I must also express the belief that the effect of the author's admirable work will be weakened by his poetic but fantastic interpretation of the tints of spoonbills and flamingoes. No less than three out of the sixteen coloured plates illustrate the hypothesis that the rosy, red or white and red colours of these birds represent the sky at sunset or dawn. Not only is there the obvious difficulty that such tints are fleeting, but there is the further objection—fully recognised by the author—that against sunset or dawn itself the birds, whatever their colour, could only appear black; and that, therefore, they could only represent

the tints reflected in some other quarter of the sky. In deprecating the introduction of these plates I feel bound to allude to their remarkable beauty. They are magnificent; but in such a place they are an injury, and not an aid to science. It is also extremely improbable that the author is correct in his opinion that the colours and patterns of male birds when far more brilliant than the females are still essentially cryptic. In the absence of incontrovertible positive evidence furnished by careful observations in the natural habitats of the species, it would be unjustifiable to accept the hypothesis illustrated by the beautiful representation of the peacock in Mr. Thayer's plate 1; of the male wood ducks in his plates 3 and 4; and the male birds of paradise in his plate 6.

Birds' eggs are commonly white when laid in inaccessible places or hidden from sight in holes or covered nests; they are commonly coloured when exposed on the ground or in open nests. This antithesis suggests that the colour of eggs is protective—a conclusion obviously true of many birds, such as the plover. Certain species which nest on open ground even possess the instinct of scattering fragments of shell, etc., over the surrounding earth, thus creating a background which promotes concealment. And even when eggs are bright blue, and at first sight appear to be conspicuous, it by no means follows that they are really so in Nature. The whole subject requires investigation in the spirit of Mr. Thayer's work on obliteration. When such an inquiry is undertaken, it will probably be found that birds' eggs which stand out

conspicuously against their cotton-wool backgrounds in the drawers of museums are very far from conspicuous in Nature.

Imitative resemblance is probably even rarer among birds than mammals. Northern birds in their white winter plumage, without obliterative shading (see page 115), may resemble lumps of snow, and Mr. Thayer also considers that the North American screech owl may sometimes resemble a bit of a branch. The ostrich in certain attitudes is said to bear a marked likeness to a bush. The concealing coloration of birds is more commonly protective than aggressive, but predaceous species with anticryptic colours and patterns are numerous.

The mode in which the beautiful winter plumage is gained by Arctic and Alpine birds (figure, page 115)

THE CONCEALING COLOURS OF ANIMALS

requires experimental investigation, and offers at least as promising a field of inquiry as the corresponding changes in mammals.

CRYPTIC RESEMBLANCES IN REPTILES AND AMPHIBIA

The concealment of these two groups of animals is chiefly oblitative, and often due to a patternless single colour, harmonising with the tint of the surroundings, as in many brownish-green and bright green snakes, lizards, and frogs. Ordinarily, however, a background-picturing pattern is added to the counter-shaded body. Concealment is more commonly aggressive than in the higher classes we have been considering hitherto. Imitative resemblance is rare, as compared with oblitative, but many examples will at once occur to the naturalist, such as the protective likeness of the little green tree-frog (*Hyla*) to a bud or folded leaf, and the aggressive resemblance of the huge python, hanging like a broken branch from a forest tree, as it lies in wait for prey. We also find in the amphibia an interesting modification of the ordinary methods of concealment, assistance being rendered by the use of foreign objects. Thus, the horned frog of South America (*Ceratophrys*) sits motionless in a hole scooped in the ground, and also covers a large part of its back with earth. In part concealed by this means and in part by its dark greenish colour, the frog waits patiently for prey. Concealment thus afforded may be called allocryptic or adventitious cryptic resemblance. It is found in many insects, especially during their larval and pupal stages. In these, however, it is nearly always alloprocryptic or employed for the purpose of defence, whereas in the horned frog it is allanticryptic.

We now meet, for the first time, and in both reptiles and amphibia, the remarkable power possessed by the individual of adjusting its colour to that of any ordinary environment. It is not only possessed by chamæleons (see page 105), but also by other kinds of lizard and frog. In all cases the change is brought about by the stimulus of light upon the eye. It was shown in 1905 that the little South African chamæleon (*Chamæleon pumilus*) possesses the power of adjustable neutralisation of

shadow, the illuminated side being dark, and the shaded side bright, and the compensation so accurate that the two sides of the animal appear to be of exactly the same shade of green. The observation was made much earlier by J. S. Beuttler, but the meaning of the adjustment was hidden until Mr. A. H. Thayer's great discovery of the neutralisation of shadow.

CRYPTIC RESEMBLANCES IN FISHES

Mr. Thayer points out that the fishes of the open sea possess a constant and simple oblitative coloration. "The gradation of shades and tints—from silvery-white bellies to dusky backs on almost all free-swimming pelagic and freshwater fishes, is true and delicate and exquisite beyond description. Among fishes of the same general form and habits, however distantly related, this oblitative shading varies scarcely at all from species to species. Even their colour-tones differ but little. They almost all wear exquisite, soft, water-colours—green, olive, grey, pearl-blue, silvery, deep olive-brown, etc. These tints are all components in the oblitative shading, and its resultant uniform, soft, water-tone, and have, in general, little independent pattern-effect" (Thayer: pages 161, 162). Exceptions are afforded by the glassy transparent pelagic larvæ of fishes, and notably by *Leptocephalus*, now known to be a stage in the life-history of the eels. All these immature fish possess the same method of concealment as the hydrozoa, or "jellyfishes." In *Leptocephalus* even the blood is transparent, a very rare phenomenon in the vertebrata; for in nearly all of them respiration is only rendered possible by the red colouring matter of blood, hæmoglobin, the carrier of oxygen to the tissues.

Certain African fishes (of the Silurid genus *Synodontis*) "are much in the habit of floating or swimming leisurely on the surface with the belly in the air, as was well known to the ancient Egyptians, who have frequently depicted the fish in this anomalous position." Now, the two species in which this reversal of the usual attitude is best known exhibit a reversal of the usual system of colouring, the ventral surface being dark brown or black,



THE EGGS OF THE OYSTER-CATCHER LAID AMONG PEBBLES SIMILAR IN FORM AND COLOUR

The lefthand picture shows a view of three eggs, to be found exactly in the centre of the picture. The righthand picture shows a close view of these same eggs. From photographs by W. Bickerton



A BRITISH MOTH AT REST ON LICHEN-GROWN WALL
Polia flavicincta. From photograph by Mr. A. H. Hamm

and the dorsal a pale silvery grey. It is impossible to imagine a more beautiful confirmation of Mr. Thayer's principle.

In the shallow waters near the shore the resemblance of fishes is often imitative, a very good example being the long, green, bandlike pipe fish, *Siphonostoma typhle* (figure, page 114), found in the zosteria beds around the English coasts. The apparent flatness of this fish is doubtless due to counter-shading, and its appearance to this extent is obliterative; but taken as a whole it is imitative, the contour, attitude, and colour (except for the counter-shading) being all suggestive of the green, strap-like leaf of the zosteria, floating upright in the water. The rounded profile of the face resembles the end of the leaf, while the fins, which would interfere with the cryptic likeness, are obliterated, partly by transparency, partly by their rapid vibratory motion. Among the commonest and most beautiful of the cryptic resemblances of fishes are the sand-and-gravel-picturing patterns of those that haunt the well-lighted bottom of shallow water. Mr. Thayer has pointed out that these patterns are accompanied and rendered efficient by obliterative shading.

The chamæleonic power of colour-adjustment is very highly developed, and very commonly present in fishes. Mr. Charles H. Townsend, who has published many beautiful illustrations of these colour-changes, states that in the northern fishes, which he has studied in the New York Aquarium, "the changes are *slow*, requiring days or even weeks; but the colour-changes of tropical species are *sudden*, or actually *instantaneous*" (figure, page 119). The following label is attached to the Aquarium tanks containing fishes liable to such rapid changes:

"This species *may change colour* at any moment.

"A few minutes' observation of the fish is usually enough to reveal a change either in colour or in pattern of marking.

"The colour-cells of the inner skin are under the instant control of the fish.

"Under natural conditions the changes of colour are made chiefly for the purpose of

concealment from enemies. They are also used for the capture of prey, for signalling, warning, mimicry, courtship, and other purposes."

The ordinary cryptic changes in the colours of fishes are due to the stimulus of light upon the eye, and blind fish lose the power of colour adjustment. But the condition of the nervous system may become the cause of rapid changes, such as those which follow excitement of various kinds.

CRYPTIC RESEMBLANCES IN INSECTS

Until the appearance of Mr. Thayer's book, obliterative coloration would have been held to play but a small part in the insect world. It must be admitted, however, that this conclusion will probably need revision in the light of the American naturalist's observations on caterpillars which rest with their most brightly coloured surfaces downwards and in the strongest shadow. And even as I am writing these pages there arrives confirmation of Mr. Thayer's views in a letter from Mr. Joseph Neale, of Bournemouth, who finds that the large caterpillars which have come under his observation assume a resting position in which shadow is obliterated. In this very position, namely, the caterpillar horizontal, with its back downwards, Mr. Neale points out that the oblique stripes of sphinx larvæ (figure, page 111) resemble the high light on projecting oblique leaf-veins, while the darker borders of these stripes resemble the shadows of the veins. In the ordinary position in which the larvæ are figured, the shadows are represented by dark borders *above instead of below* the stripes which stand for the veins.

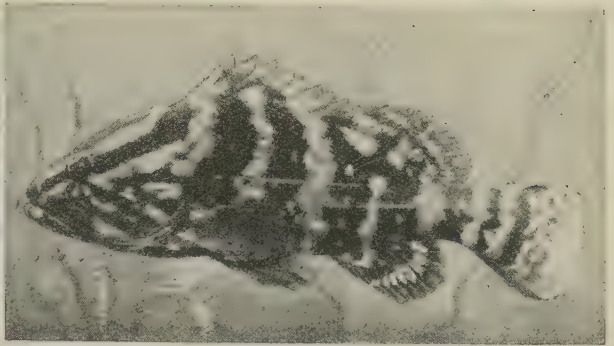
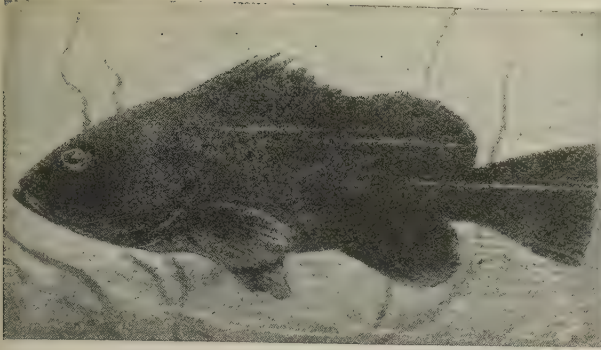
Although it is probable, in the light of the observations alluded to in the last paragraph, that obliterative counter-shading plays a far more important part in insects than has been supposed hitherto, there can be no doubt that imitative resemblance is their chief method of concealment. Furthermore, the counter-shading here co-operates with the rival principle of imitation instead of replacing it. By its means, for example, the appearance of flatness is given to a chrysalis which in all other respects bears the most beautiful imitative resemblance to a leaf. (See page 111, and figure, page 112.)

Even a brief account of the imitative resemblances of insects would occupy the whole space



COMMON WHITE BUTTERFLY ON A WHITE DAHLIA
An example of an insect seeking an appropriately coloured resting-place
From photograph by Mr. A. H. Hamm

THE CONCEALING COLOURS OF ANIMALS



TWO STATES OF THE NASSAU GROUPE, A FISH THAT CAN CHANGE ITS COLOUR IN AN INSTANT

Many tropical fishes have the power of rapidly varying their colours when excited, feeding, or when alarmed. In the latter case they make for a hiding-place, assuming a dark colour. From an illustration by Mr. Charles H. Townsend

allotted to this article. Every characteristic feature of the vegetable kingdom becomes the model for protective likeness—leaves of all colours and conditions of decay and injury, and of many shapes (figures, pages 106, 107, 111, 112, 118); twigs and branches of all textures and tints; the rough bark of the trunk, sometimes brown and at others greyish green with lichen or bright green with alga; buds and the brilliant colours of flowers (figure, page 113); fruits and seeds in utmost variety. Rather than attempt to describe examples, which may be found by every observer of our British insects, I will refer to certain important aspects of cryptic resemblance in this section of the animal kingdom.

It is sometimes argued that the protective resemblances of insects are due to superficial characters, but it must be remembered that the colour and pattern would be useless without the co-operation of instinct leading the species to select an appropriate background and adopt an appropriate attitude. The wonderfully precise and accurately adjusted instincts of insects have been clearly produced by natural selection acting upon the central nervous system, and cannot be explained as the inherited memory of intelligent actions. Many of the instinctive actions, e.g., cocoon-making, are performed but once in a lifetime, and are adapted to meet the dangers of the future rather than the present.

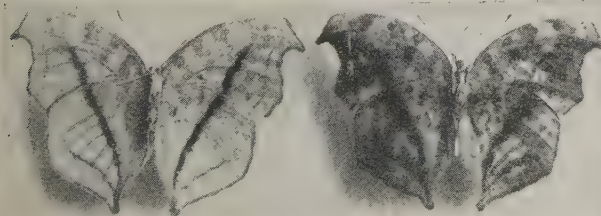
The power of adjusting colours to those of a particular normal environment is widely possessed by caterpillars and by the exposed chrysalises of butterflies, but the changes are slow, and have never been shown to depend on the eye. In all chrysalises the power can only be exercised once in a lifetime, in caterpillars not more than two or three times. This is sufficient; for the first cannot wander at all, while

the second, during their period of growth, wander but little. The most striking result that has been obtained hitherto is the production of greenish or grey lichen-like marks upon stick- or bark-like caterpillars—the effect of the presence of lichen-covered sticks in the surroundings. When sticks without lichen were present, caterpillars—the offspring of the same parents as the others—only produced traces of the marks, or did not produce them at all. The species employed were the Lappet (*Gastropacha quercifolia*) and the Scalloped Hazel (*Odontopera bidentata*). It is probable that effects such as these are wrought by the stimulus of reflected light upon the nerve-endings in the skin, and are never produced directly as on the photographic plate.

No insect in the perfect state has been shown to possess the power of adapting its colours to any particular environment, but it is probable that such an adjustment can be effected in many species. In 1901 I observed that a very abundant grasshopper was invariably reddish brown, like the earth, upon the island of Heligoland, but that the same species was always sand-coloured or green on the flat, sandy Düne, separated by three-quarters of a mile of sea.

Similarly, my assistant, Mr. W. Holland, has observed that a well-known weevil (*Cleonus sulcirostris*) is reddish brown on the red sand of Boar's Hill, Oxford, but dark grey on the neighbouring Shotover Hill. In all such cases we have to decide between two probable interpretations. The local resemblance may be due to an individual susceptibility like that of many caterpillars, or may be due to the local operation of natural selection. Experimental investigations of a very laborious kind are required in order to reach a safe decision. The only experiment

of the kind as yet undertaken was made upon a common British moth, *Gnophos obscurata*, well known to be dark in peaty and pale in chalky districts. The experiment showed that, at least from the mature caterpillar stage onwards, there was no susceptibility, and I therefore concluded



TWO DRY-SEASON OFFSPRING (LEFT) AND A WET-SEASON PARENT (RIGHT)

The African *Precis antelope*, showing the under sides of the wings. The dry-season offspring are dead-leaf-like and beautifully concealed. The wet-season parent is conspicuous, and perhaps a very rough mimic of an *Acræa*

that the local colours are the result of natural selection, the pale forms becoming exterminated on peat, the dark on chalk. There is little doubt that this is the interpretation of the recent progressive darkening of many moths in the smoke-producing districts of Lancashire and Yorkshire and the adjacent area to which the smoke is carried.

Over this large part of the North of England, bark-frequenting lichens and algæ are killed, and the trunks of trees present a uniform dark, sooty appearance, forming a background against which a greyish variegated moth would stand out conspicuously. These local developments of a dark colour in the moths of smoky districts—observed on the Continent as well as in England—may be compared with an interesting Irish example recorded by Mr. W. F. de V. Kane. On the south-west coast of Ireland, at places where the rocks are dark-coloured, melanistic examples of a common geometrid moth (*Camplogramma bilineata*) were found intermixed with the ordinary yellow individuals, while on a small island off the coast selection had been carried much further, and only black forms (the var. *isolata*) occurred. The end was tragic, for Mr. Kane informed me that the last time he visited the spot it had been swept by storms and the whole island race exterminated.

It is impossible to do more than allude to the large body of observations upon the seasonal changes of insects. In northern latitudes, the differences between the early and late broods of the same species sometimes correspond to differences in the surroundings, and thus promote concealment. In tropical countries the dry-season forms are often better concealed than those of the wet season, when the struggle for existence is less severe.

The vast majority of insect resemblances are protective, but examples of Aggressive Imitative Resemblance are to be found in the predaceous leaf and flower-like *Mantidæ* (figure, page 113), but even in these the likeness is also of value as a protection against insect-eating enemies.

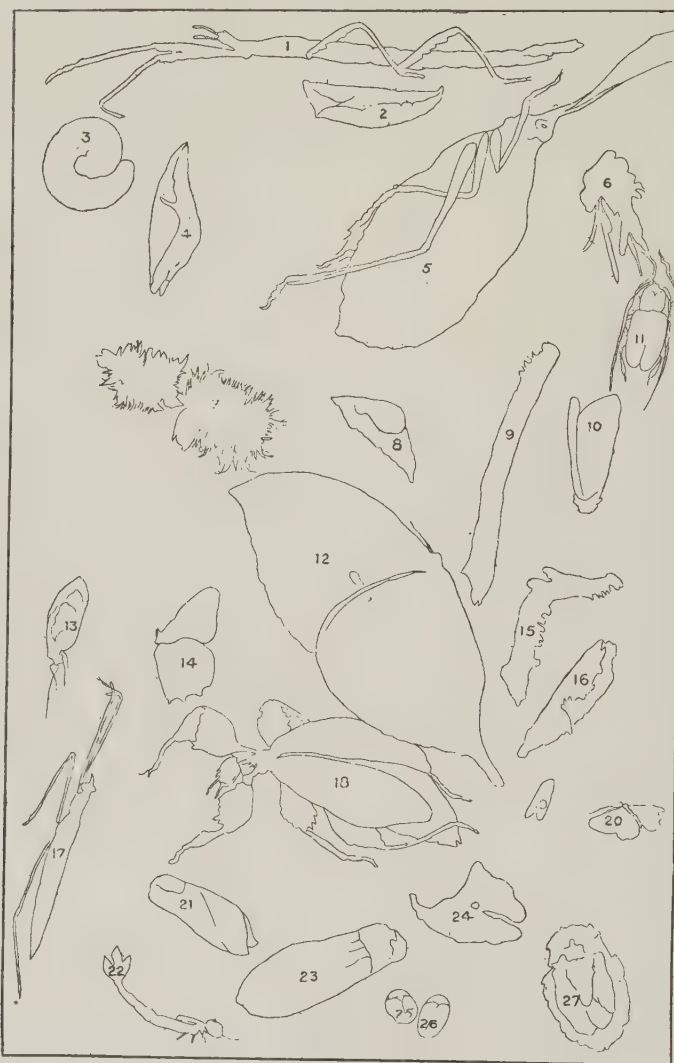
In the above outline of the vast subject of insect

concealment I have attempted to select for consideration those aspects which, it is hoped, will induce the reader to think and make observations for himself. A more detailed treatment will be found in the author's "Essays on Evolution" and "Darwin and the Origin."

Concealment for defence or attack is by far the most important of all the uses to which the superficial colours of animals are put. Mr. Thayer argues that it is well-nigh the only use, and that all combinations of colours and all patterns serve the purpose of concealment. With this conclusion I cannot agree, fully believing that special modes of defence are associated with special types of appearance, easily seen and remembered by enemies (Warning Colours), and that such types often advantageously resemble each other (Common Warning Colours, or Müllerian Mimicry), and become the models for mimicry by animals without special modes

of defence (False Warning Colours, or Batesian Mimicry). I believe, furthermore, that the brilliant colours of the males displayed in courtship (Epigamic), and have been gradually developed by the choice of the female. But all these purposes, although they are undoubtedly of the highest interest, are insignificant when compared with the great purpose which has been briefly sketched in the present article.

EDWARD B. POULTON



KEY TO COLOURED PLATE, PAGE 106

1, Stick insect, *Bacillus rossii*; 2, Chrysalis of *Papilio podalirius*; 3, Larva of *Cimex letulæ*; 4, Chrysalis of *Apatura ilia*; 5, Leaf-like locust, *Pterochroza colorata*; 6, Psychid caterpillar; 7, *Pemphigus xyloste*; 8, Chrysalis of *Rhodocera rhamnii*; 9, Caterpillar of *Arapteryx sambucaria*; 10, Scarce *Merveil du Jour* moth, *Moma orion*; 11, *Mesosa cerculionoides*; 12, Dead-leaf butterfly, *Kallima philarchus*; 13, Dead-leaf mayfly, *Drepanopteryx phalaenoides*; 14, Green hairstreak butterfly, *Thecla rubi*; 15, Caterpillar of *Notodonta ziczac*; 16, Chrysalis of *Papilio evander*; 17, Water-bug, *Ranatra linearis*; 18, Leaf insect, *Phyllium sicifolium*; 19, *Tortrix ocellaria*; 20, Clouded border moth, *Abraxas marginata*; 21, Green silver-lines moth, *Haliopsis prasiana*; 22, Young dragonfly; 23, Bufftip moth, *Phalera bucephala*; 24, Cocoon of *Aides amanda*; 25, Histerid beetle; 26, Byrrhid beetle; 27, *Phloeocorticata*.

THE CLASSIFICATION OF ANIMALS

By R. LYDEKKER, F.R.S.

IN dealing with any large assemblage of objects of different kinds, whether natural or artificial, it is absolutely essential to have some definite plan of arranging, or classifying, them in order to be able to refer to each type individually, and also to understand the relationship of one to the other. Such arrangements, or classifications, may rest on different bases. We may arrange the various objects according to the countries from which they come; this being what is called a geographical or distributional classification. On the other hand, when we have to do with extinct as well as living animals, we may arrange them according to their respective ages. This is a chronological classification. Now, either classification affords much information when applied to animals, including extinct as well as living types. But a still more valuable classification of the animal kingdom is one based on the mutual relationships, and the grade of development of its various members, so far as these can be ascertained; this being termed a systematic, or natural, classification.

Even the naturalists of antiquity, such as Aristotle, attempted a natural classification of animals, but signally failed, owing to their taking one structural character, or a common feature in the mode of life, as a basis for grouping together or sundering the various species. A new light dawned, however, upon systematic natural history, or rather zoology—for natural history in its fuller sense comprises the study of plants and minerals as well as animals—during the eighteenth century when the great Swedish naturalist, Carl Linné, or Linnæus, as his name, according to the fashion of the time, was Latinised, invented a system which has become the foundation stone of all modern methods of classification.

Linnæus had the merit of seeing that animals are divisible in the first place into species—we will discuss races later—and that species are capable of being arranged in groups, the members of which exhibit a greater or lesser degree of resemblance to the one taken as the type of such group. Thus, all the members of the animal we know as the British wild cat constitute a *species*. But, although the name “cat” properly belongs only to the wild animal and its domesticated relatives—or possibly only to the latter—yet there is a number of other carnivorous animals which present a more or less marked resemblance to that species, such as lions, tigers, leopards, pumas, and tiger-cats.

Taking the wild or the domesticated cat as the starting-point, Linnæus grouped with that species a number of other more or less cat-like animals into what he called a *genus*. Moreover, as the English language does not lend itself nicely to classifications of this nature, he gave to the cat a species as well as a genus name in Latin. Thus the wild cat became

Felis catus; *Felis* being the genus, or generic name, and *catus* the species name. Within the same genus are included the lion, tiger, leopard, puma, and tiger-cat under the respective names of *Felis leo*, *F. tigris*, *F. pardus*, *F. concolor*, and *F. tigrina*; with a number of other closely allied species.

There is, however, another animal, the so-called hunting leopard, or chita, of India and Africa, which, while agreeing in a number of characters with the cats, yet differs in certain features, notably in the absence of the power of completely retracting the claws, from all the animals which can well be included under that name. When such a different type is met with it is referred to a different genus; the chita being called *Cynælurus jubatus*.

But although a chita differs much more from all the more typical cats than does any one of the latter from any other, yet it is obviously much more nearly related to these animals than it is, for instance, to a wolf or a dog. This affords grounds for making a division of higher rank than a genus, namely, a *family*. Consequently we have the wild cat (*Felis catus*) and the chita (*Cynælurus jubatus*) brigaded together as members of the cat tribe, or cat family, under the name of *Felidæ*; while, on the other hand, the wolf (*Canis lupus*) and its African relative the hunting dog (*Lycaon pictus*), which belong to distinct but allied genera, collectively constitute a second family group—the *Canidæ*, or dog tribe. The members of the cat tribe agree, however, with the dog group in their carnivorous habits as well as in the general type of structure of their teeth, and many other features in their organisation. Consequently, the *Felidæ* and the *Canidæ*, together with a number of other families, are combined in a group of still higher rank, known as an *order*, in this case termed the Carnivora.

But this is not all, as the members of a number of orders of animals agree with one another in the common character of nourishing their young by means of milk secreted by the female parent, and sucked or otherwise imbibed by the young. All such animals, whether they be four-legged terrestrial creatures like dogs and cats, or marine animals with the front limbs modified into paddles and the hind limbs absent, like whales and sea cows, are grouped in one great *class*, known as sucking animals, mammals, or, technically, Mammalia.

Going a step farther, we find that mammals, birds, reptiles, salamanders, fishes, and lampreys agree with one another in possessing a jointed rod, or axis, popularly called the backbone or spine, but scientifically the vertebral column, running along the middle line of the back. To express this community of character the classes furnished with a vertebral column, of which the individual units are the vertebræ, constitute a *subkingdom*, known as the Vertebrata.

There are, however, certain other groups of animals

possessing what may be called a kind of rudimentary backbone, the notochord, and these are brigaded with the Vertebrata under the designation of Chordata.

All other animals are without this structure, and in consequence are often collectively termed invertebrates, or Invertebrata; although this term is usually employed in a general rather than in a strictly systematic sense. These so-called invertebrates are divisible into a number of subkingdoms, such as the Echinoidea, or sea urchins and starfishes, and the Arthropoda, or jointed animals, such as lobsters and insects, of equal rank with the Vertebrata.

Finally, all these subkingdoms form sections of the animal kingdom, or Animalia, as distinct from the vegetable kingdom, or Plantæ.

In addition to the partition into subkingdoms, the animal kingdom is split into two primary divisions, namely, the Protozoa, or animals whose whole body consists of but one cell, or primary organic unit, and the Metazoa, or those whose bodies are formed by the aggregation of a number of such cells.

Thus we have the following grades of classification :
Subkingdom : VERTEBRATA.

Class : MAMMALIA.

Order : CARNIVORA.

Family : *Felidæ*.

Genus : *Felis*.

Species (a) : *Felis catus*—cat.

Species (b) : *Felis leo*—lion.

Linnaeus used generic terms in a comprehensive sense, but the general tendency of modern naturalists has been to reduce the limits of these groups, in many cases to a very unnecessary extent. The older naturalists, when reducing the extent of a genus, considered it permissible to allow the species-name of an animal to be made the type of a new genus in a generic sense, and accordingly the fox—the *Canis vulpes* of Linnaeus—became, in the view of those who considered it entitled to represent a genus by itself, *Vulpes communis*. Not so, now say the purists; a species-name must remain a species-name for ever, and accordingly they have rechristened the fox *Vulpes vulpes*. A more absurd instance of pedantry and slavish adherence to a self-made rule could scarcely be conceived.

This, however, is by the way; and it remains to give the following list of subkingdoms and of classes into which the existing representatives of the animal kingdom may be divided.

SYSTEMATIC ARRANGEMENT OF THE LEADING GROUPS OF THE EXISTING MEMBERS OF THE ANIMAL KINGDOM.

KINGDOM ANIMALIA

DIVISION A. COMPOUND ANIMALS..METAZOA

Subkingdom I. Backboned Animals ..Vertebrata

CLASS

1. MammalsMammalia
2. BirdsAves
3. ReptilesReptilia
4. Salamanders and Frogs.. ..Amphibia
5. FishesPisces
6. Lampreys and Hagfishes ..Cyclostomata

Subkingdom II. LanceletsCephalochordata

Subkingdom III. BalanoglossusHemichordata

Subkingdom IV. Sea Squirts, or Ascidians ..Urochordata

Subkingdom V. Sea Urchins and Starfishes..Echinodermata

CLASS

1. StarfishesAsteroidea
2. Brittle StarsOphiuroidea
3. Sea UrchinsEchinoidea
4. Sea CucumbersHolothuroidea
5. Sea LiliesCrinoidea

Subkingdom VI. Jointed Animals ..Arthropoda

CLASS

1. Lobsters and BarnaclesCrustacea
2. CentipedesMyriopoda
3. InsectsInsecta
4. Spiders and ScorpionsArachnida

Subkingdom VII. Lamp ShellsBrachiopoda

Subkingdom VIII. Sea MatsPolyzoa

Subkingdom IX. Worms and Leeches ..Annelida

CLASS

1. Worms and SerpulasChætopoda
2. LeechesHirudinea
3. Gephyrean WormsEchiuroidea

- Of uncertain rank
 { Sipunculoidea
 { Priapulidea
 { Phoronidea

Subkingdom X. Shelled AnimalsMollusca

CLASS

1. Nautilus and CuttlefishesCephalopoda
2. Whelks and LimpetsGastropoda
3. ChitonsPlacophora
4. Tooth ShellsScaphopoda
5. BivalvesLamellibranchiata

Subkingdom XI. Wheel AnimalculesRotifera

Subkingdom XII. Thread WormsNemathelminthes

CLASS

1. Round WormsNematoda
2. Thread-shaped WormsNematomorpha
3. Spiny-headed WormsAcanthocephala

Subkingdom XIII. Nemertean WormsNemertea

Subkingdom XIV. Flat Worms and Flukes..Platyhelminthes

CLASS

1. TurbellariansTurbellaria
2. TrematodesTrematoda
3. Liver Flukes, etc.Cestoda

Subkingdom XV. Corals and Sea Anemones..Cœlenterata

CLASS

1. PolypsHydromedusæ
2. JellyfishesAculephæ
3. Corals and Sea AnemonesActinozoa
4. Beroë, etc.Ctenophora

Subkingdom XVI. SpongesPorifera

CLASS

1. Lime SpongesCalcarea
2. Glass SpongesTriaxonina
3. Ordinary SpongesDemospongiæ

DIVISION B. ONE-CELLED ANIMALS..PROTOZOA

CLASS

1. Amœba and ForaminiferaGymnomyxa
2. Ordinary AnimalculesInfusoria
3. Blood Parasites, etc.Sporozoa

There is no consensus of opinion as to what constitutes a genus or a species, and it has been proposed, in certain cases, to split up genera into subgenera, and species into local races, or subspecies. There exist, for instance, certain more or less well-defined local forms or varieties of the tiger. If these are treated as distinct species, all connection with the typical tiger is completely lost. If, on the other hand, they are regarded in the light of local races of a single variable species, the connection is maintained, so that a species may be split up into local races or subspecies as represented in the case of the tiger by the following :

The Tiger : *Felis tigris*.

The Indian race, *F. tigris typica*.

The Manchurian race, *F. tigris longipilis*.

The Persian race, *F. tigris virgata*.

The Malay race, *F. tigris sondaica*.

CHARACTERISTICS OF THE VERTEBRATA

VERTEBRATES, which, in their higher phases, are the most perfectly organised of all animals, take their name from the presence of a jointed rod extending from the back of the head to the hind extremity of the body or the tip of the tail—when this appendage is developed—and known as the backbone, or vertebral column.

The joints, or segments, of which this generally flexible column is composed are known as vertebrae; and although usually formed of bone in the adult, in some of the lower vertebrates these vertebrae may permanently retain the cartilaginous condition in which they are first developed. Each fully-developed vertebra consists of two distinct portions, a basal portion, forming a disc-like or cylindrical solid segment, known as the centrum, and above this—or, in the case of the human species, at the back of this—an arch supported on two pillars, and terminating in a more or less well-developed spine. Perhaps from the presence of these spines, the whole backbone is commonly called the spine.

In the canal formed by the arches of the vertebrae, the so-called spinal canal, is contained what is known as the spinal cord, or spinal marrow, a rope-like structure formed of grey and white nervous tissue protected by a strong fibrous sheath; this cord running backwards—or, in the case of man when in the upright posture, downwards—from the brain, of which it is, in fact, a continuation, to the hind extremity of the body.

The spinal cord is thus seen to lie in a tube situated, in the ordinary position of quadrupeds, above, or, as naturalists say, on the dorsal side—from the Latin *dorsum*, “the back”—of the bony or cartilaginous column formed by the centra, or bodies, of the vertebrae. On the opposite side of the backbone to this nervous, or neural, tube is a much larger tube or cavity containing the viscera, such as the heart, lungs, stomach, and intestines. Accordingly, if a transverse section be made across the body of a vertebrate, it will be found to comprise two tubes—a smaller one on the dorsal side, containing the spinal cord; and a much larger one on the lower, or ventral—from the Latin *venter*, “the stomach”—side of the centra of the vertebral column, containing the viscera.

Another noteworthy peculiarity of vertebrates is that the limbs, which never exceed four in number, are always directed away from that aspect of the body which contains the spinal cord, and towards that enclosing the viscera; whereas in all the invertebrates, the reverse is the case. Vertebrates are likewise distinguished by the fact that the two jaws work in a vertical plane, or, in other words, are upper and lower, instead of being right and left, as they are in insects.

In this connection it is of the highest importance to notice—although we are getting on difficult ground—that the vertebral column is developed from a primitive structure known as the notochord,

which persists throughout life in the groups classed in the table on page 122 as the Cephalochordata, Hemichordata, and Urochordata, but in the Vertebrata is found only in the embryo. The occurrence of this structure in these subkingdoms has been regarded as the most important feature of the whole assemblage, the members of which are consequently brigaded together under the common designation of Chordata, or animals with a notochord, in contradistinction to the Invertebrata, in which it is absent.

The Chordata are likewise distinguished by certain other structural features of importance, and more especially by the existence of lateral outgrowths from the pharynx, or throat, which unite with the skin of the neck to form a series of perforations leading to the exterior. These perforations persist in fishes as the gill-slits; but, with the assumption of a life on land, have been lost in the higher vertebrates as functional organs, respiration being performed by lungs in place of gills. Even in the higher vertebrates, however, the gills are apparent in the embryo, and remains of one pair can usually be detected in the adult.

Here it may be mentioned that the fact of whales breathing by means of lungs is a conclusive proof of their descent from land animals, for had they been directly derived from fishes they would certainly have retained gills, which are in many respects better adapted for an aquatic existence, although it is doubtful if they could act with sufficient energy to maintain the blood at the high temperature characteristic of mammals.

The Vertebrata—or, as they are often termed, Craniata—are distinguished from the lower Chordata by the formation of a distinct head, combined with the internal structure known as the skull for the reception of the brain.

Although the lowest members of the group—not to speak of the lower Chordata, which are probably, in some degree, at any rate, degraded animals—are decidedly inferior to many of the higher forms of invertebrates, yet vertebrates as a whole are clearly the supreme and highest development of the animal kingdom, their most advanced type, the mammals, being, in truth, the “winners in life’s race,” and culminating in man himself, who, we are told, is but “little lower than the angels.” The development of brain-power has been the dominating agency in the evolution of the higher vertebrates, and it is the big-brained mammals which have gradually and completely ousted the reptiles which in former ages were the dominating animals of the land.

In the sea conditions naturally are different, and the lowly-organised fishes have maintained their supremacy alongside of the more highly organised whales and dolphins; and, indeed, are likely to persist long after all the larger representatives of the cetaceans have, owing to the intervention of man, been exterminated.

R. LYDEKKER

MONARCHS OF THE WILD IN CAPTIVITY



LION AND LIONESS



TIGER

From photographs by Gambier Bolton, F Z.S., by permission of the Autotype Company, 74, New Oxford Street, W.

THE KINGDOM OF MAMMALS

A SKETCH OF THE VARIOUS ORDERS AND THEIR CHARACTERISTICS

By J. ARTHUR THOMSON, M.A.

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TO the naturalist, every class of animal is interesting, but a special human interest attaches to the warm-blooded, hair-covered, milk-giving quadrupeds which Linnæus called mammals. For it is to this class that man belongs. Apart from "the all-pervading similitude of structure" between man and other mammals, which Sir Richard Owen long ago spoke of, the instinctive and intelligent behaviour of mammals often approaches human conduct in a curiously suggestive way. In illustration, we need only refer to the behaviour of mammals in courtship and in bringing up their young, to the activities of the play-period, and to the mutual aid among gregarious and social species. There is a special interest also in the educability of many mammals, for it has led in a number of cases to their intimate domestic association with man, who has acted as a directive factor in their evolution, replacing Nature's automatic sifting by a deliberate artificial selection.

There are said to be about three thousand different kinds of living mammals, and an equal number of extinct forms. Many of the latter are without direct descendants, for a distinction must always be drawn between extinct forms which are represented to-day by lineal or collateral descendants, and extinct forms which are in the strict sense lost races. Without taking the fossils into account in the meantime, we may state one of the first impressions of a visit to a museum-gallery of mammals, or to a good zoological garden—that the class is a most motley assemblage. What a gamut of size from the harvest mouse, that can run up a stalk of wheat, to the gigantic whale; what a variety of habitat—the earth and under the earth, the moor and the loch, the shore and the open sea, the mountains and the air itself; what differences in locomotion, in diet, in intelligence, in disposition, in number of offspring; and, implied in all this, what diversity of structure between the duckmole and the monkey, the whale and the bat, the sea cow and the horse, the mole and the elephant! In short, we find among mammals a remarkable variety of habit and habitat, and of form and structure adapted thereto. They have possessed the whole earth, they exploit it in a multiplicity of ways, and they show a correlated counterpart of bodily adaptation.

There are three grades of mammals—monotremes, marsupials, and placentals.

1. The monotremes—otherwise known as prototheria and ornithodelphia—include three genera, the duckmole and two spiny ant-eaters, which differ markedly from all other mammals in being oviparous. In other words, they lay eggs which are hatched outside the body. In addition to this singular feature, it may be noted that the monotremes are, in certain respects, primitive and reptilian-like.

2. The marsupials—otherwise known as metatheria and didelphia—include a large number of genera, such as kangaroo and bandicoot, phalanger and wombat, all confined nowadays to the Australian region, except the opossums (in North and South America) and the selvas (in South America). Most of the females have an external pouch, or marsupium, to which the tender young are transferred, and within which they are nourished and protected for a considerable time. This strange arrangement is in correlation with the fact that the organic connection between the unborn young and the mother is much less developed than in higher mammals, and that the young are born after a short gestation, as it were prematurely, unable even to suck. The mother has to inject the milk down the throats of her offspring.

3. The placentals—otherwise known as monodelphia and eutheria—include numerous orders, such as carnivores, ungulates, rodents, insectivores, bats, and monkeys. As compared with marsupials, they show a well-developed organic union (allantoic placenta) binding the unborn young to the mother's womb, and the brain displays in most cases a considerable advance.

There are so many different orders of placental mammals that we are apt not to see the wood for the trees. Therefore it may be of service to notice that there have been three main lines of evolution, each leading to great success. There is the herbivorous line of advance, best represented by the very successful order of hoofed mammals, or ungulates; there is the carnivorous line of advance, best represented by the very successful order of beasts of prey, or carnivores; and there is the series which leads through various grades of monkeys to a climax in man. On the herbivore line a premium was on hoofs and horns; on the carnivore line it was on teeth and claws; on the simian line it was on brains.

This is not to be regarded as a classification, though it is in some ways the result of one. It indicates the significance of the great evolutionary movements. It must, however, be noted (1) that there are several archaic orders—the sirenians, the sloths, the ant-eaters; (2) that the herbivorous rodents, the insectivora, and the lemurs, correspond in a general way to the ungulates, the carnivores, and the monkeys; (3) that there are several very divergent orders, notably, the cetaceans and the bats, to which may be added the divergent family of men; and (4) that some of the entirely extinct orders are of a generalised character, and unite several of the now widely separated modern orders. To take a single type, as an instance, it is believed by some that the extinct phenacodus, which figures as an early member of the horse lineage, has affinities with the ungulates, the carnivores, and the lemurs.

THE EGG-LAYING MAMMALS

The oviparous monotremes are represented by the duckmole in Australia and Tasmania, the spiny echidna in Australia, Tasmania, and New Guinea, and another spiny ant-eater, also from New Guinea, which is often referred to as a distinct genus, *Proechidna*. They are exceedingly interesting mammals in many ways, because they exhibit certain reptilian affinities, because they are primitive compared with higher forms, and because they have numerous peculiarities. Let us illustrate each of these points in turn.

The monotremes show several reptilian features. The pectoral girdle resembles that of lizards—the coracoids meeting the breastbone, and so forth—the temperature of the body is unusually variable, the creatures being, in fact, imperfectly warm-blooded; the eggs are relatively large, with abundant yolk, and hatch outside the body. There are many more technical evidences of reptilian affiliation.

The monotremes are primitive in many respects. Thus the milk is exuded on the skin, without there being any teats, on a bare flat patch with numerous openings in the duckmole, in a depression within a temporary pouch in the spiny ant-eaters; and the young ones lick it, instead of sucking. Another instance may be found in the state of the brain, which is primitive, especially as regards the commissures passing from one side to the other, when compared with ordinary mammals. The rudimentary ribs attached to the vertebrae of the neck remain distinct for a time at least—and this is another primitive feature.

The monotremes have many peculiar features which cannot be called either reptilian or primitive. The skull is smooth and polished as in birds, bone fusing to bone at an early date. In the echidna there is no trace of teeth even in the embryo; in the duckmole there are true mammalian teeth, twelve in all, but only in the young, for after the first year or so they are lost, and replaced by horny

plates. On the side of the ankle in the duckmole there is a spur perforated by the duct of a gland, and there is a similar smaller one in the spiny ant-eater. These peculiar structures may be used by the males in fighting; they are rudimentary or absent in the females. As other examples of peculiarities we may note the soft, sensitive collar of the duck-

mole where the flat bill joins the rest of the skull, or the long, tubular snout and long, worm-like tongue of the spiny ant-eater. Thus we see that the monotremes are in some respects reptilian, in others primitive, in others quite peculiar.

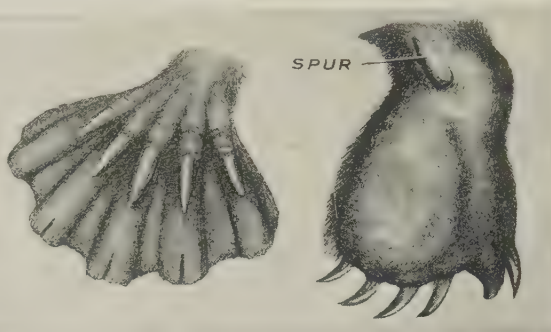
The duckmole, or platypus, is a shy aquatic animal, swimming and diving well. It grubs in the mud for insect larvæ, crustaceans, and worms, collects them in its cheek-pouches, and chews them at leisure when

it ascends to breathe. The webbed fingers are obviously adapted for swimming. But they are clawed as well, and, along with the hind feet, are used in making long burrows in the banks. In further adaptation to aquatic life, we may note the short fur, the very inconspicuous ear-flap, the short, flat tail, and the soft collar, which seems to

have considerable tactile sensitiveness. Like the hedgehog and some other animals, the duckmole rolls itself into a ball when about to sleep. In the recesses of the burrow, which has often two openings, one above and one under water, the female lays two eggs, each enclosed in a flexible white shell, through which the young animal has to break its way.

The spiny ant-eaters live in dry, rocky regions, and are nocturnal in their habits. Their spines afford ample protection, and the animals burrow very rapidly

when molested, sinking vertically into the ground so that when they have got a little way down they are unattackable. Their limbs are very strong, and when they get a grip among the scrub it is very difficult to dislodge them. The long snout and viscid, worm-like tongue, which is jerked out and drawn in with great rapidity, are adapted to catching ants. A single



THE FORE AND HIND FOOT OF THE DUCKMOLE

The web of the fore foot is folded back when digging. The hind foot has not such an extensive web, and bears a spur, the use of which is uncertain



DUCKMOLES IN THEIR HABITAT

This monotreme, sometimes called the duck-billed platypus, makes a long burrow which has one opening in the bank and another under the water, as shown in the above sectional drawing

THE KINGDOM OF MAMMALS

egg is laid, and it is at once placed in a temporarily developed external pocket, where it is hatched—a hint of the state of affairs in marsupials.

THE MARSUPIALS

mammals, or marsupials, include a great variety

of types: (1) the arboreal opossums (*Didelphys*), the aquatic yapock (*Chironectes*) which catches fish; (2) the dog-like Tasmanian wolf (*Thylacinus*), the civet-like dasyure (*Dasyurus*), the banded ant-eater (*Myrmecobius*); (3) the unique notoryctes, with mole-like habits; (4) the burrowing bandicoots (*Perameles*); (5) the divergent South American selvas (*Canolestes*); (6) the large, somewhat bear-like wombat (*Phascolomys*), with rodent-like dentition; (7) the woolly arboreal phalangers (*Phalanger*), the small, mouse-like honey-eating tarsipes, the large koala, or "native bear" (*Phascolarctos*); (8) the terrestrial herbivorous kangaroos (*Macropus*).

This list is necessary to show that the marsupials constitute more than an order of mammals; they form a subclass by themselves. The figures indicate the eight families composing the subclass: Opossums, dasyures, notoryctids, bandicoots, selvas, wombats, phalangers, and kangaroos, and the point of special interest is that there are many suggestions of placental orders. The dasyure prefigures a carnivore, notoryctes a mole, the wombat a rodent, the kangaroo a herbivore, and so on—not that the resemblances in any case mean more than similar adaptations to similar conditions of life, or habits.

The facts in regard to the geographical distribution of marsupials are of peculiar interest. First, there is the palæontological fact that marsupial types once had a wide range in Europe and America. Their fossil remains prove this. Second, there is the fact that, with the exception of the American opossums and the South American selvas, all the living marsupials are natives of the Australian

region. Third, there is the fact that no mammals, except marsupials, are indisputably indigenous to Australia. Fourth, there is the geological fact that the great island-continent of Australia was in former ages connected with Asia by a land bridge

across the Java Sea. Reconstructing the past, then, we may say that marsupials were exterminated in many parts of their wide range as the better-brained placental mammals gained a footing, that they reached Australia before their placental competitors had arrived, that the insulation of Australia saved them, and gave them a new territory in which to evolve,

relatively unhindered, for long ages in many different directions. And it is this that gives point and interest to the number of varied types to which we have called attention.

For an alliance so heterogeneous as that of the marsupials it is difficult to find general characters. Those that are most readily intelligible have to do with the production of offspring. In the first place, the marsupials do not carry their young before birth so long as is usual in placental mammals. The

gestation, as it is called, lasts only a fortnight in the opossum, about five weeks in the kangaroo. Furthermore, the organic connection between the embryo and the mother is of a simple type, except in the bandicoot, where the ordinary condition seen in the placentals is exhibited; the young are born very helpless, unable even to suck; they are transferred at once to the external pouch, or marsupium (which is absent in some opossums), and there the milk is forced down their throats by the contraction of a muscle around the mammary gland.

Another intelligible general character relates to the brain, which is less developed than in the average placental mammal. But, when we go further, we are arrested by the fact that the most general characters do not seem to have much direct



THE SPINY ANT-EATER, A CURIOUS MONOTREME
The long snout, with the worm-like tongue, is adapted for catching ants



THE LONG-SNOURED PHALANGER, A TINY MARSUPIAL
This little creature is very similar in form and size to the common shrewmouse. The female is provided with a well-developed pouch for carrying its young



THE BEAR-LIKE WOMBAT OF TASMANIA
A marsupial that lives in burrows or clefts in the rocks

meaning. In all marsupials, except tarsipes, the angle of the lower jaw is turned inwards towards the similarly inflected angle on the other side; the cheekbone (molar or jugal) reaches far back to share in making the socket (glenoid cavity) in which the lower jaw works; there are more incisor teeth in the upper jaw than in the lower except in the wombat; and so forth. But these general characters, it should be added, are not in themselves significant, they are only indices of something deeper.

THE EDENTATES

Under the title edentates is included a number of very distinct types which cannot be compelled within the rubric of a single order. They may be appropriately called "living fossils." More precisely, they are the specialised survivors of waning and probably very primitive stocks whose golden age is long since past. They are not very nearly related to one another, and there seems little warrant for connecting them with any of the other present-day orders of mammals.

In the New World there are the arboreal sloths (Bradypodidae) of South and Central America, the shaggy, toothless South American ant-eaters (Myrmecophagidae), and the armadillos (Dasypodidae), which range from Texas to Patagonia, unique in their encasement of body skin-plates. Along with these may be ranked the extinct ground sloths, or megatheriidae, one of which—a very fortress—exceeded the rhinoceros in size, and the likewise extinct glyptodons, whose body was often huge and covered by armour of great strength.

Seemingly built not for a day but for all time, these glyptodons and similar types, highly specialised as regards defence, have passed entirely from the lists of life, while less evolved types persist and prosper. But it must be remembered that the day of the glyptodons was of no mean duration.

In the Old World there are the Oriental and Ethiopian pangolins, with strong, horny scales covering their back, like slates on a

roof, and the shy, nocturnal armadillos of Africa, but these two types have not much in common.

If these edentates are living anachronisms, it is useful to consider them from that point of view, to inquire into the protective features in structure and in habit, which secure their survival in the modern world. The shaggy hides of the sloths—the most arboreal of all mammals—harmonise with the mosses and lichens on the branches, and the protective resemblance is increased by a remarkable greenish tint on the hairs, due to a unicellular plant like that which makes tree-stems green in wet weather. The armadillos are covered with bony shields and rings, they can roll themselves up into unopenable balls, they run quickly and burrow quickly, and they come out at night—a very remarkable combination of protective adaptations. The African armadillos that burgle the hills of the white ants are destitute of armour, but they make deep burrows and are shy nocturnal creatures. Just as simple dwarfish peoples among mankind have in different countries and ages taken refuge in forests and underground—becoming, in fact, fairies and gnomes—so most of these quaint edentates, survivors of a bygone age, linger on in burrows and among the branches, living a quiet, unobtrusive life, avoiding the glare of day unless the possession of strong armature lends them the welcome assurance of temporary security in the wilder parts of the earth.

THE SIRENIANS, OR SEA COWS

Another peculiar order is that of the sirenians, represented nowadays by two sluggish aquatic vegetarian types, the dugong and the manatee. A third type, Steller's sea cow, from the North Pacific, belonging to the genus *Rhytina*, seems to have been exterminated in the eighteenth century.

We may take these quaint creatures as an illustration of what is meant by evolutionary convergence—the occurrence of similar adaptations in types which are not closely related to each other. It is evident that the sirenians are in several ways like cetaceans: in both we notice the plump, rounded body, the horizontally flattened tail, the absence of hind limbs, the flipper-like form of the fore limbs, the great reduction of hairs on the skin, and so on. Even inside the body there are many resemblances,



THE RABBIT BANDICOOT, AN OMNIVOROUS MARSUPIAL
This creature derives its popular name from its large ears

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such as the backward extension of the lungs, the very oblique midriff, or diaphragm, and the occurrence of wonderful networks of blood-vessels (retia mirabilia). But when we go further, we find that in regard to other organs the structure is fundamentally different—*e.g.*, as regards brain, dentition, skull, backbone, larynx, and stomach. The two orders are not nearly related, but they have undergone similar adaptations to similar conditions of life. From the structure of halitherium and other extinct relatives of the living Sirenia, it seems that the unknown ancestors must have been related to the ungulates, or hoofed mammals, and probably to a stock from which the elephants also diverged.

CETACEANS

The baleen whales, such as the right whale (*Balæna*), the humpback (*Megaptera*), and the rorqual (*Balænoptera*), differ in so many ways from the toothed cetaceans, such as the sperm whale (*Physeter*), dolphin (*Delphinus*), porpoise (*Phocæna*), and narwhal (*Monodon*), that it is an open question whether there should not be two orders of "cetaceans." Waiving this, however, let us consider the cetaceans as illustrating what is meant by adaptations. That their ancestors were quadrupeds, there can be no doubt, but how far is the body of modern cetaceans from being supportable on four limbs! Yet the spindle lies comfortably in the water and is well suited for cleaving it. The hind limbs are represented at most by internal vestiges, the fore limbs have become flippers, the tail is horizontally flattened into flukes, the skin has lost almost all its hair, a thick layer of blubber retains the animal heat and makes the animal buoyant, the ear has no trumpet and the sound must travel inwards through the bones of the skull, the lungs are greatly elongated backwards, helping the animal to lie horizontally in the water, there is a neat contrivance for enabling the creature to breathe and swallow at the same time, and so on through a long list of characteristic modifications, for, as Weismann has well said, "*Take away the adaptations from the whale and how much is left?*" The whale's body is a huge bundle of adaptations.

HOOFED MAMMALS, OR UNGULATES

One of the most successful lines of mammalian evolution has been that leading to the modern ungulates—a terrestrial, herbivorous series, in which the bones of the palm and the sole stand high off the ground and the nails usually grow round the ends of the digits to form hoofs. It is a rather heterogeneous order, including unwieldy forms like the rhinoceros and hippopotamus, graceful forms like the gazelles and roedeer, quaint old-fashioned types like the giraffe and the okapi, highly specialised

modern types like the horse and the elephant. More precisely, the ungulate alliance includes: (1) the even-toed pigs and peccaries, hippopotamuses, camels and llamas, chevrotains, and the true ruminants—cattle, sheep, deer, okapi, and giraffes; (2) the odd-toed rhinoceros, tapir, zebras, asses, and horses; (3) the small rodent-like coneys, or hyraxes; and (4) the elephants. Besides the living ungulates there are many extinct types, some of them of very large size, and often "generalised"—that is to say, exhibiting characters which connect what are now separate orders. Better, perhaps, than any other types do the fossil ungulates—*e.g.*, those in the lineage of the horse and the elephant—furnish proof of the reality of gradual evolutionary advance from the general to the special.

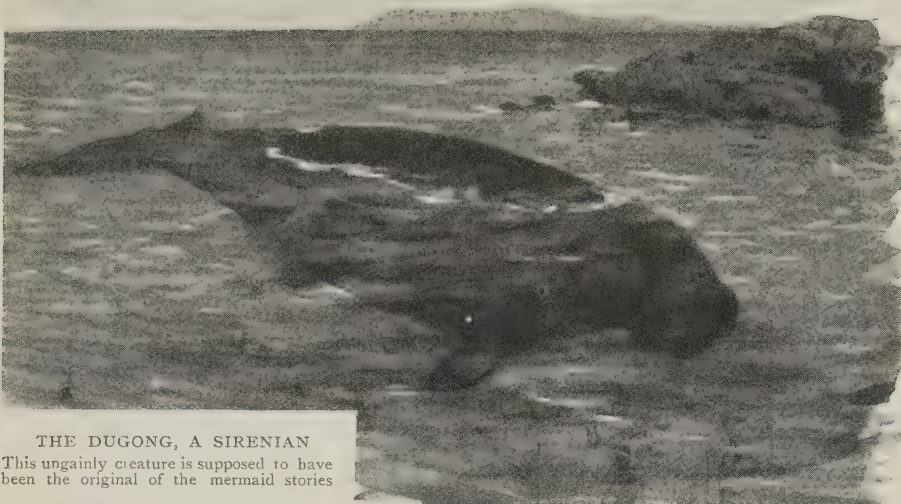
RODENTS

There are more members of this order than of any other among mammals. They succeed not because they are strong, certainly not because they are clever, but because they are many. They are represented in

all parts of the world, having gained access, through man's heedlessness, even into Australia, the "preserve" of marsupials. Most are terrestrial and small and vegetarian, but the water vole is very largely aquatic, the capybara is four feet long, and rats are omnivorous. Quite characteristic are the chisel-edged incisor teeth—an almost mechanical adaptation, for the hard enamel is either restricted to the front of the teeth, or is extremely thin posteriorly, so that as the lower teeth work against the upper, the back part wears away more rapidly, and thus a chisel-edge is formed. The lower jaw works



PÈRE DAVID'S DEER, AN UNGULATE OF MANCHURIA



THE DUGONG, A SIRENIAN

This ungainly creature is supposed to have been the original of the mermaid stories

backwards and forwards with considerable play, and a characteristic "munching" results—very familiar in the rabbit. Some rodents, such as squirrels and rats, make affectionate pets; viscachas, prairie dogs, jerboas, and other forms have attractive habits; and one hears tales of the beaver's ratiocination. Nevertheless, on the whole, the rodents, or gnawing animals, form a distinctly "lower order"—that is, a relatively unintelligent one.

CARNIVORES

As successful as the ungulates, but in a very different direction, are the carnivores, which include four great tribes: (1) the cats, large and small, the civets and mongooses, the aard-wolf, and the hyæna; (2) the dogs, wolves, jackals, and foxes; (3) the bears, raccoons, otters, skunks, badgers, martens, sables, stoats and weasels; and (4) the seals, the sea lions, and the walrus—adapted for marine life. Most of them prey upon other animals and devour their warm flesh, and in adaptation to this habit there are well-developed claws, sharp teeth, keen senses, and agile movements. Most are bold and fierce animals, but there is a well-marked play-period in youth, which is always a mark of great educability. We see the climax of this educability in the dog.

As in other cases, it is most useful to consider the general characteristics in relation to the dominant habits and conditions of life. Thus, if we examine a lion's skull,

we see the strong crests for the better fixing of the muscles, the deep socket for the lower jaw, which gives the animal a strong grip and permits only of up-and-down movement, the protruding cheekbones bounding a large space for the muscles of the lower jaw, the strong killing canines and a specialised cutting blade among the back teeth. If we watch the domestic cat, we see the tiptoe tread, the neat contrivance for retracting and protruding the claws, the sensitive hairs on the face, and curious details of habit which appear as reminiscences of the arboreal wild stock.

INSECTIVORES

This is an order of small mammals in some superficial respects like rodents, but on a quite different line of evolution. Shrewmice, moles, hedgehogs are familiar types, but there is so much diversity that brief characterisation is very difficult. Most of the insectivores run about on the ground, but the mole has sought safety and earthworms underground, a few are aquatic, and a few arboreal. As regards brains, they represent a low level of organisation, and many of them are otherwise primitive. Some, however, like the mole, are highly specialised. It is interesting to notice how many rodent types have their counterparts among the insectivores—the mouse balances the shrewmouse, the jerboa the jumping shrew, the water vole the water shrew, the porcupine the hedgehog, and so on; but, as has been said, there is no close relationship. According to



PRAIRIE DOGS, OR PRAIRIE MARMOTS

Rodents that dig burrows and share them with the ground owl and rattlesnake, all living amicably together

THE KINGDOM OF MAMMALS

many authorities, a separate order is required for the remarkable flying foxes (*Galeopithecus*) of the Malayan Archipelago and the Philippines, which have the fore and hind limbs connected by a parachute, and are able to glide for half a hundred yards, or more, from one tree to another.

BATS

Undoubtedly related to the insectivora—though their popular name is flitter-mice—the bats are the most specialised of mammals. Like the birds and the extinct flying dragons, they have discovered the secret of flight, and their whole structure is adapted thereto. The wing is formed by a fold of skin, which usually begins at the shoulder, extends along the upper margin of the arm to the base of the thumb, thence from one long finger to another, and eventually down the sides of the body to the hind legs, or even to the tail.

Among the bat's adaptations to flight we may notice the following: The bones are slender, and the long bones have large medullary cavities; the backbone has little mobility, but serves as a stiff fulcrum; the breastbone has a slight keel for the insertion of muscles; and so on. Even the fact that there is usually only one offspring at a time may be correlated with the flying habit. In many ways bats are peculiar. Thus the sense of touch is extraordinarily acute, and is located in the hot skin of the wing, the large mobile external ears, the whisker hairs of the snout, and in strange plaited "nose-leaves" around the nostrils. This tactility is, of course, to be associated with their crepuscular habits, for they have to catch small prey in scanty light. Some of the larger bats are fruit-eaters, but the great majority are strictly insectivorous. In cold countries bats hibernate, hanging head downwards from the roofs of caves, wrapped up in their wings.

LEMURS

Leading on to the monkeys, but remaining at a much lower level, are the lemurs. Their name means ghosts, and they are ghost-like in their silent movements and in their love of darkness. Most of them are nocturnal, and all are arboreal. They are small, soft-furred mammals, with fox-like faces, and with considerable resemblance to monkeys. In early

Tertiary times they had a much wider range than now, occurring, for instance, in Europe and North America. In the latter continent they became extinct; in the Old World they migrated to Ethiopian and Oriental regions. Of the fifty or so living species there are thirty-six in Madagascar. It seems that they must have reached that region while it was still connected with Africa, and that insulation took place before any of the larger carnivora had got across. Where they have not been insulated, they linger in forests—a feeble folk, without the brains or agility of monkeys, saved only by their quiet, shy ways. Although there are some highly specialised lemurs, such as the aye-aye of Madagascar, famous for its extraordinarily long skeleton-like third finger, and the Indo-Malayan tarsier, of weird appearance, the lemurs, as a whole, are lowly organised creatures, and link the monkeys to the lower mammals.

PRIMATES

The title of this order indicates its pre-eminence—the pre-eminence of including man. Man is the supreme mammal, and his lineage, though we do not know its details, is simian. We began our survey by pointing out that a special interest attaches to the class Mammalia because we who study it are mammals—deny it as men often do in their conduct and policy—and we end our survey by pointing out that the interest is intensified in the case of the primates, for it is from within this order that the ascent of man began. It must be

carefully noticed, however, that within the order there are many grades, each of which represents a big step in evolution. The New World broad-nosed monkeys, usually called platyrrhines, are at a level anatomically far below the Old World, narrow-nosed catarrhines, which include the four anthropoid apes; but they are also very different, and it is not improbable that the order has developed from two distinct roots, one leading to the marmosets and American monkeys, the other leading to the more dog-like baboons and macaques, and to the more man-like gibbons, orangs, chimpanzees, and gorillas.

DIET OF MAMMALS

It has been well said that "animals, from their own point of view, have two, and only two, occupations in the world. These are to care for themselves and to care for their offspring." It is interesting to



THE VISCACHA, A FAMILIAR RODENT OF THE ARGENTINE

These animals are related to the chinchilla which yields the lovely fur

consider the general life of mammals in this light, beginning with the securing of food, which is the first and fundamental chapter in the never-ending story of caring for self. What a variety of food-getting we find—the duckmole collecting small bivalves on the floor of the pond, the Cape ant-eater breaking into the hills of the termites, the sea cows browsing on seaweeds and estuarine plants, the giraffe reaching up to the leaves on the high branches, the reindeer scraping off the snow to get at the lichens, the right whale rushing through the ocean with enormous gape, engulfing myriads of sea butterflies and other pelagic fry, the sperm whale doing battle with huge squids, the lion devouring antelope, the bear berries, the seals fish, the mole pursuing the earthworms underground, the hedgehog searching for the grubs of beetles, the bats feeding on insects, the monkeys plundering the orchard, and how many more!

SELF-PROTECTION AMONG MAMMALS

An adequate picture of a class of animals must include some illustration of the give and take between its members and their enemies. There are some that stand confident in their strength, such as lions and tigers, elephants and rhinoceros; there are others that avoid controversy, preferring to lie low and say nothing. Some are more or less secure in their armour—*e.g.*, porcupines and hedgehogs, armadillos and echidnas; others are well equipped with weapons—teeth and claws, horns and hoofs. The greenish sloth is inconspicuous among the branches, often shaggy with epiphytic plants, and some of the antelopes in their khaki suits are hard to see in the veldt. Some, like the armadillo and hedgehog, roll themselves into balls; others burrow quickly and are gone; the flying foxes, the flying squirrels, and the flying phalangers show similar extensions of skin that enable them to save themselves by taking great swoops from tree to tree; the jerboas, the squirrels, and some lemurs and monkeys have a surprising swiftness of leap; the bats and many others have become creatures of the night. But there is no end to the variety of self-protection.



THE INSECTIVOROUS HEDGEHOG AND YOUNG

When the hedgehog is alarmed, it rolls itself into a ball, presenting a formidable surface of spikes to its assailant

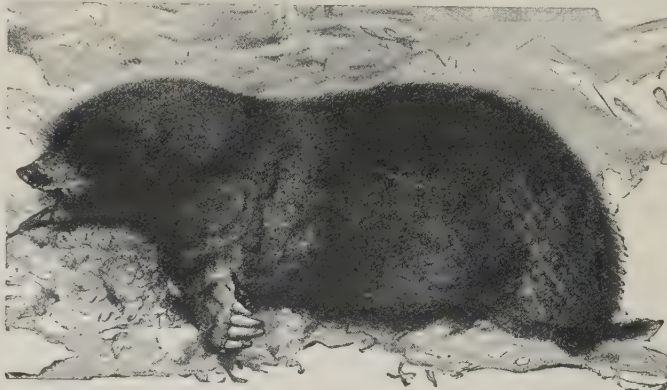
ADJUSTMENT TO PHYSICAL SURROUNDINGS
It is plain that the structure of the mammal's body is often well adapted to its particular environment: the spindle-shaped porpoise to the open sea, the snake-like weasel for creeping through holes, the monkey with its five hands for gymnastics among the branches. Similarly, the white Polar bear is suited in its colour to the snow and ice of the Far North, and the tiger to the tropical jungle. The more penetrating our observation, the more of this fitness of structure do we discover: the mole's hand is a marvellously effective spade, the elephant's nasal dexterity passes belief, the horse's legs are suited for galloping on tiptoe. The adaptations are found in the inmost recesses of the body: the sheep's four-chambered stomach is fitted for rumination, the whale's lungs are very large and long, the heart of the swift ungulates is specially suited to stand the strain. But we follow the quest farther, and find

that in many cases the mammal is able to adjust itself in an effective way to changes in its surroundings. Thus the stoat, mountain hare, and Arctic fox turn white in winter, becoming at once safer and physiologically more comfortable; the hedgehog, dormouse, marmot, and bats fall into a strange coma when the cold of winter sets in; there are also interesting migrations—reminding us of those among birds—for instance, in the reindeer and some antelopes, in seals and also among cetaceans.

MATING AMONG THE MAMMALS

It is interesting to compare birds and mammals in regard to their wooing. In many birds the males display their beautiful plumage, their graceful flight, their powers of song, apparently working up excitement in their desired mates.

Among mammals there is also some display both of beauty and of vocal powers, but the wooing is on the whole much more forcible. Rival males—*e.g.*, stags and sea lions—fight fiercely with one another, and the females follow the conqueror. The antlers of stags, the horns of antelopes, the great tusks of the narwhal, and the large canines of boars are used



THE MOLE, AN INSECTIVORE WHICH LIVES UNDERGROUND

The mole's hand is peculiarly adapted for burrowing

THE KINGDOM OF MAMMALS

as weapons in these battles of the males; while manes and beards, bright colours and strongly scented secretions, seem sometimes to play a part in exciting the females and overcoming their coyness. It is interesting to notice how profoundly the nature of the animal may be modified at the breeding season: minute alterations are effected in remote corners of the body, and the whole temper may be changed. The timid hare becomes a fierce and heedless combatant, and love is often stronger than hunger. But if the courtship of mammals is like a storm in violence, it is also soon over, for while there are exceptional pairs that marry, such as beavers and some antelopes, remaining constant year after

internal parasite, within the mother, sharing the details of her life. In a complicated way—a *chef d'œuvre* of contrivance—the unborn offspring, enwrapped in ante-natal vestments, obtains food and oxygen, and gets rid of its waste products by what may be called vital diffusion between its blood and that of the mother. There is a passage of fluids and gases from the mother to the offspring and conversely, and, though no ordinary solid particle can pass the filter, living microbes sometimes get through from the mother, bringing about an infection before birth. But the point that we wish to emphasise is that the connection between mother and offspring is very thorough and very subtle. There is much



TWO SEA LIONS AT PLAY ENGAGED IN A SHAM FIGHT

From a photograph by Mr. F. Martin Duncan

year, this is not the way with the majority. After the pairing season is past the males usually return to their ordinary, often solitary, life; and, in the great majority, the family life is distinctly matriarchal.

ANTE-NATAL LIFE

No one can understand mammals, even a very little, without taking account of the way in which the young are carried within the womb of their mother. The monotremes, as we have seen, lay eggs; the marsupials bring forth their young prematurely, and stow them away—in most cases—in an external pocket; but in placentals there is a period of gestation in which the young creature lives, like an

nurture before birth; there is a "mysterious wireless telegraphy of ante-natal life." Very interesting also are the special adaptations to the life before birth; thus, to take a detail, the claws sometimes show—as in reptiles and birds—an embryonic "glove finger," which disappears soon after birth, but is probably of use in saving the delicate vestments from being torn by movements of the embryo.

In his well-known pre-Darwinian essay on evolution, "The Vestiges of Creation," Dr. Robert Chambers suggested that the prolongation of the period of ante-natal nurture would give the brain time to grow more complex, so that there came about, in the course of ages, a gradual improvement in



STAGS FIGHTING IN THE MATING SEASON

mammalian intelligence. Whether this theory be right or not, there is no small interest attaching to the length of the gestation in different kinds of mammals. We give a few figures from a very valuable study by Dr. John Beard ("The Span of Gestation and the Cause of Birth." Fischer, Jena, 1897)—horse, 336 days; cow, 280-287; man, 276-280; sheep, 145-150; pig, 112-120; guinea-pig, 63-66; dog, 58-64; cat, 56; kangaroo, 38; rabbit, 30½-31; white mouse, 19½-19¾; opossum, 7½. These periods are doubtless wrapped up along with other periodicities in the mammal, but three interesting points may be noted. The period of antenatal life is, on the whole, longer in the higher types; longer in the larger than in the smaller forms at the same level of organisation; and longer when the number of offspring born at a time is small.

In regard to the condition of the young mammals at birth, we may quote a suggestive statement made by Sir W. H. Flower: "In those forms which habitually live in holes, like many rodents, the young are always very helpless at birth; and the same is also true of many of the carnivora, which are well able to defend their young from attack. In the great order of ungulates; or hoofed mammals, where, in the majority of cases, defence from foes depends upon fleetness of foot, or upon huge corporeal bulk, the young are born in a very highly developed condition, and are able almost at once to run by the side of the parent. This state of relative maturity at birth reaches its highest development in the cetacea, where it is associated with the conditions under which these animals pass their existence."

It is scarcely surprising that great biological interest should attach to the play of mammals, which is familiar to everyone in the case of kittens, puppies, lambs, kids, foals, and the like.

THE PLAY OF MAMMALS

As may be supposed, the simplest forms of play are gambols and frolics. Also fundamental is the game of experiment, in which the animal, without serious purpose, tests things, itself, or its fellows; and from these roots arise more complex forms of play—the sham hunt, the race, the sham fight, and so on. The subject has been thoroughly studied by Prof. K. Groos, who shows that play is more than an expression of overflowing energy whose forms are defined by imitation, that it is rather

the outcrop of definite instincts, which have been evolved like other instincts, arising by germinal variation, and fostered in virtue of their utility. But what can be the utility of play, which by definition has no serious purpose? To this Groos answers that play is the young form of work—a rehearsal without responsibilities, a sham fight before the battle of life begins, a preliminary canter before the real race. Animals play because they are young, but it is perhaps as true that they have a period of youth in order that they may play. A second justification of play is found in the opportunity it affords for exercising and perfecting instinctive activities, which, therefore, do not require to be so definitely engrained in the cerebral constitution. Thus play is a device for lightening the burden of inheritance, which leaves the brain more educable. Thirdly, it is a very suggestive idea that the play-period affords opportunities for initiatives, new departures, and idiosyncrasies, before the struggle for existence has become keen. The playing animals are notably plastic and docile, and, apart from a few cases—like sheep—they are also notably intelligent.

THE STRUGGLE FOR EXISTENCE

The "balance of Nature"—the established order of things—is a *moving equilibrium*, which requires to be continually readjusted. Whenever there is a disturbance or dislocation of the established interrelations, whenever there is a conflict of interests, whenever the lusty, self-assertive living creature is confronted with difficulties and limitations, we have the struggle for existence. For, as Darwin clearly

THE KINGDOM OF MAMMALS

recognised, this includes much more than an internecine struggle around the platter at the very margin of subsistence, it includes every thrust and parry in face of difficulties, every reaction against environing limitations, every endeavour after well-being which makes for the survival of the stock. In face of difficulties or limitations one alternative is, of course, increased competition, but another is increased combination; and Nature has, so to speak, approved of both lines of solution, as is particularly well seen in the case of mammals.

Let us first of all, however, illustrate from the natural history of mammals the *reasons* for the struggle for existence. The first reason is to be found in the tendency to over-population, for struggle is the safety-valve against the internal pressure of rapidly increasing population. The slowest breeder among mammals is the elephant; it is supposed to rear a single young one every ten years, but, as it lives to more than a hundred, it can have a fairly large family before the end of its days. And Darwin calculated that in 750 years each pair of elephants would, if all their offspring lived and bred, be the ancestors of nineteen millions. It is well known that the rabbits introduced into Australia about 1860 soon became calamitous in their prolific multiplication; and every few years there is over-population among the Scandinavian lemmings, or among the common field voles. The river of life continually tends to overflow its banks.

A second reason for the struggle for existence is to be found in the pattern of the web of life—there are nutritive chains, one link depending on another for support. Thus the carnivores struggle with the herbivores and the herbivores with the carnivores, in natural antipathy deeply rooted in the past and

justified by the conditions of the present. A third reason is the irregular changefulness of the physical environment, which is quite careless of life. Mammals have to struggle with the vicissitudes of Nature—with *weather* in the widest sense. There is a fourth reason for the struggle for existence which is often overlooked—namely, the self-assertiveness of the vigorous animal, which elbows its way through the crowd, jostling its neighbours.

We find among mammals vivid illustrations of the three chief forms of the struggle for existence.

1. The struggle between nearly related fellows is well seen in the deadly combats between the brown rat and the black rat. Here it is war to the death. The black rat, which seems to have migrated from the East, was in possession of many European towns when the stronger and fiercer brown rat—perhaps a native of Mongolia—crossed the Volga about 1727; but wherever the brown rat arrived the black rat had practically to go to the wall. Thus, at the present day, there are almost no black rats in Britain. It may be admitted that the arrival of the brown rat, which is much more obtrusive than the black rat, roused man to more strenuous methods of extirpation, which were naturally more effective against the weaker species, but there can be no doubt as to the keen competition between the two kinds, and the result that the weaker goes to the wall. Similarly, in South Africa to-day one of the fiercest and most aggressive of the native rats (*Mus microdon zuluensis*) seems quite unable to compete with imported European brown rats and black rats, and has consequently disappeared in the larger towns when the immigrants have established themselves. The next step is that the brown immigrant ousts the black immigrant, forcing it from town to country.



A STAG FOLLOWED BY ITS MATES, FOR WHICH IT HAS FOUGHT ANOTHER STAG

The struggle between fellows of the same or of nearly related species need not be for the necessities of daily life—for food, foothold, or breathing-room; it may be for such luxuries as a fourth or fifth wife, as in the case of the sea lions, which fight fiercely for the increase of their harem. It is difficult to exaggerate the fury of the combats between rival stags or antelopes. Or, to take a quite different instance of struggle for a luxury, the wild stampede of the reindeer when the longing to visit the salt seashore becomes irresistible. Many are overthrown and trampled in the mad rush.

2. The struggle between foes which are not nearly related to one another is seen in the manifold thrust and parry between herbivores and carnivores, between the small rodents and insectivores, on the one hand, and the birds and beasts of prey on the other.

3. The struggle with Fate—between the living creature and the changeful, merciless physical conditions—is seen in the endeavours many mammals make when the winter is more than usually severe.

The results of the struggle for existence are in the main always three, and mammals illustrate them well. (1) There may be a reduction in numbers which relieves the pressure of population without directly making for progress. The lemmings, obeying the instinct of their smooth brains to move on, an instinct that sometimes leads them to a promised land, may swim out in thousands into the North Sea, which solves their population problem, but without obviously improving the wits of the race. This is indiscriminate elimination, which never

makes for progress. (2) In many cases, the exigencies of the struggle drive the animals to seek out new habitats, to explore new territories, to adopt new habits. When the beaver village gets overcrowded there is a flitting, and whether it be true or not—probably not—that the old experienced

hands leave the huts to the youngsters, and explore for themselves, there is certainly a recurrent coercive expansion of range. It must have been thus that the whales returned to the freedom of the sea, that moles invaded the Eldorado of the earthworms, that the bats made the great venture of flight. (3) In the third place, the result of the struggle may be discriminate elimination of the relatively less fit to the

given conditions of life, and it is this kind of result that has meant most in the evolution of the races. The black rat yields before the brown rat, and there is a survival of the fittest—i.e., the fittest in respect to the given conditions. It is very important to realise that the struggle for existence will make for progress without *rapidly* killing off the less fit. For if the struggle mean that the less fit have a more difficult life, and do not live so long or so lustily, if it mean that they have smaller and less vigorous families, then it will in the long run work out to the same result as if the less fit had come to a rapid, violent end.

This struggle is going on now, and has been going on since early Triassic mammals began to emerge from their ancestral reptilian stock. Given a continuous crop of variations, and Nature's sifting, the result is Evolution.

J. ARTHUR THOMSON



TIGER CUBS AT PLAY

Photo H. Irving

The most intelligent mammals have a play-period in their youth



A COLONY OF BEAVERS AT WORK BUILDING A DAM

CHARACTERISTICS OF MAMMALS

AN ACCOUNT OF THEIR STRUCTURE, ANATOMY, & OTHER FEATURES

By R. LYDEKKER

WITH the exception of the word "beasts," there is no true English term for this group of animals, which constitutes the highest class in the vertebrate division. The term "quadrupeds" was, indeed, long in popular use, but since it is inapplicable to whales, while it would also include most reptiles, it is now largely superseded by the term "mammals," the animals in question being so named from the fact that their young are nourished by milk sucked from the *mammæ* of their mother.

In addition to the presence in the females of mammary glands secreting the milk, mammals differ from other living groups of the higher vertebrates in the mode in which the lower jaw is articulated to the skull. In other vertebrates this articulation is effected by the intervention of a separate squared bone known as the quadrate, upon the lower end of which the articular hollow of the lower jaw plays, while its upper end is wedged into the skull proper. In mammals, on the other hand, this intermediate bone is absent, and the lower jaw consequently articulates by means of a convex surface, or condyle, directly with the walls of the skull itself. Moreover, in all mammals each half of the lower jawbones consists of only a single bone, instead of several distinct bones joined together. Thus an isolated jawbone is always sufficient to prove whether its owner was a mammal or some other vertebrate. Another very important feature in mammals is that they always have hair, although it may be only a few bristles near the mouth, on some portions of their bodies during a certain period of their existence. Again, that part of the large cavity of the body which contains the heart and lungs is completely separated by a horizontal partition, known as the *midriff*, or *diaphragm*, from the cavity containing the stomach and intestines. Further, at least in all living members of the class, the brain of mammals is much more highly organised than that of other animals; one of its distinctive features being the presence of a transverse band on its lower surface, by means of which its two lateral halves are intimately connected, this being called the *corpus callosum*.

The foregoing are some of the chief features distinguishing mammals from all other vertebrates, and reference may now be made to a few characteristics in which mammals differ from certain of the lower classes, although agreeing with others. One of the most important of these differences is that the skull of mammals is jointed to the first vertebra by means of a pair of transversely disposed knobs, or condyles,

as they are technically called. In this respect mammals are broadly distinguished from birds and reptiles, in which there is only a single knob, or condyle, placed in the middle line of the skull. Frogs and newts, constituting the class of amphibians, agree, however, with mammals in the mode by which the skull is jointed to the backbone, although they differ very widely in other parts of their organisation.

On the other hand, mammals differ from fishes, amphibians, and reptiles in having warm blood, which is propelled from a four-chambered heart through a double circulatory system; one part of this system causing the blood to pass through the lungs for the purpose of taking in a fresh supply of oxygen from the air, and the other being subservient to the supply of freshly oxygenated blood to the various organs and members of the body. This circulatory

system also differs from that of birds and reptiles in that the blood for the nourishment of the body is propelled from the heart by a single vessel, known as the *aorta*, which passes over the left branch of the windpipe; whereas in birds and reptiles the *aorta* crosses either the right branch or both branches of the windpipe.

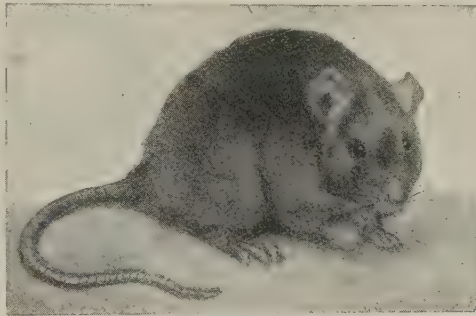
All mammals, whether they live on the land or in the water, breathe-air by means of lungs suspended in the chest; and

during no period of their life do they ever develop gills; neither do they ever undergo a metamorphosis analogous to that presented by the change of a tadpole into a frog. By these last two negative characters they are, therefore, sharply distinguished from the amphibians, with which, as we have seen, they agree in the mode by which the skull is articulated to the first joint of the backbone.

With the sole exception of the few species of egg-laying mammals, or *monotremes*, of Australia and New Guinea, which are the lowest members of the class, the young of mammals are invariably born in a living condition.

A remarkable feature in mammals is the circumstance that, with only three constant exceptions, the number of joints, or *vertebræ*, in the neck is seven; this number being equally constant in the immensely elongated neck of the giraffe, or in the extremely shortened one of the whale, in which the *vertebræ* are reduced to thin plates of bone.

As a rule, mammals have the two pairs of limbs characteristic of vertebrates, but occasionally, as in whales, the hind pair may be wanting. In a large proportion of species the hind and fore limbs are of



THE BLACK RAT

The tail is covered with scales with their edges in apposition

approximately equal length. In some cases, however, the hind limbs may be enormously elongated at the expense of the front pair, as we see in the kangaroos and jumping-mice; and progression is then effected by means of leaps and bounds from these strong hind limbs. The opposite extreme of limb-structure is shown among the bats, where, while the hind pair retain their normal structure, the fore limbs are greatly elongated to afford support to a leathery winglike structure, by means of which these strangely modified creatures are enabled to fly in the air with the same ease and swiftness as birds. In the whales and dolphins, which lead a purely aquatic life, we find the fore limbs modified into paddles for swimming, while the hind ones are, as we have said, totally wanting. Similar conditions obtain in the dugongs and manatis; but in the true seals, which are less completely aquatic, the hind limbs are still well developed, although directed backwards to form, in connection with the tail, a kind of rudder. The bats are the only mammals which are wholly adapted for flight, but we meet with certain forms in other groups, such as the flying-squirrels among the rodents, and the flying-opossums among the pouched mammals, which are enabled to take long leap-like flights from tree to tree by means of a kind of parachute formed of folds of skin running along the sides of the body from limb to limb. The limbs themselves are not, however, specially modified; and true flight, in the sense of propulsion caused by up-and-down strokes of the fore limbs, is not performed by these mammals. Something more on the subject of limbs is mentioned in the paragraphs which are devoted to the skeleton (see page 140).

Almost as great variations are displayed in the modifications and uses of the tail of mammals. In the majority of cases the tail is present and forms a tapering axis, often clothed with long hair, which may considerably exceed the total length of the body. The mammal in which the relative length

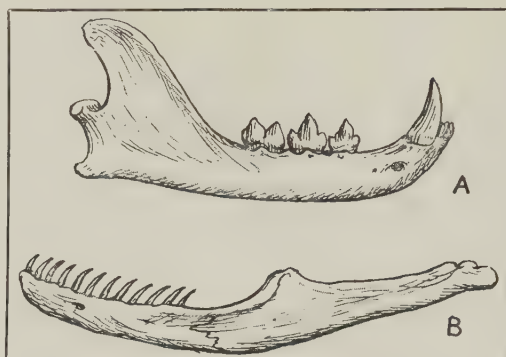
of the tail is greatest is a small species from Madagascar belonging to the insectivorous order, and known as the long-tailed tenrec, in which the tail is nearly three times as long as the body. In some of the apes and monkeys the tail is absent; and it is very short in the bears among the Carnivora, and

in many deer among the hoofed mammals, or ungulates. In many ungulates, however, such as cattle, it is of great length; and in that group its extremity is furnished with a tuft of hair, and thus forms an effectual instrument for brushing away flies from the body.

In the spider-monkeys of South America, as well as in the opossums and phalangiers, in certain porcupines, and other forms, the tail is prehensile, and serves as an important aid in climbing, or in enabling its owner to hang head-downwards. In the beaver the tail is expanded into a flattened oar-like form, which probably acts as a rudder in swimming. But the most remarkable modification of this useful organ occurs in the whales and dolphins, in which it is expanded into a large forked structure, termed by whalers "flukes," and is the main agent in propelling the body through the water.

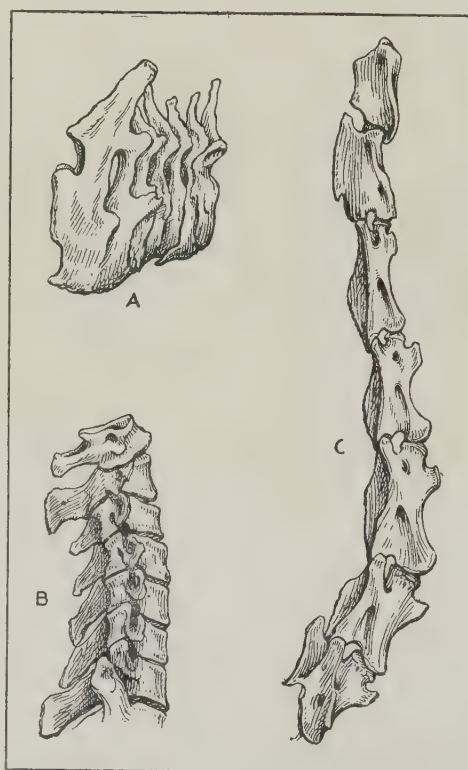
In regard to the external covering, hairs are always present on some portion of the body during some period of life. Mammals never develop that modified kind of hair-structure known as feathers, which are peculiar to birds; but the body may be covered with overlapping scales, like those so common in reptiles, although this now occurs only in the pangolins, or scaly ant-eaters of India and Africa. The tail of the common rat is an example of a part of the body covered with scales having their edges in apposition; but in both these instances hairs are mingled with the

scales. Still rarer than scales are bony plates, developed in the true skin. These structures are only met with among the armadillos, which are furnished with bucklers and transverse bands of these bony plates, and are in some cases able to roll themselves up into a ball, presenting



LOWER JAWBONES OF CAT (A) AND SNAKE (B)

By the lower jawbone alone a mammal's remains can be distinguished from those of any other vertebrate



THE NECK VERTEBRÆ OF GIRAFFE (C), MAN (B), AND WHALE (A)

In almost every mammal the number of vertebræ in the neck is seven, whether they are elongated as in the giraffe or reduced to thin plates of bone as in the whale. A, whale; B, man; C, giraffe

CHARACTERISTICS OF MAMMALS

on all sides an impenetrable coat of mail. In the Pleistocene, or latest geological period before the present, however, South America produced a number of mammals allied to the armadillos, and known as glyptodonts, which were covered with a continuous cuirass of bony plates, reaching in some cases more than an inch in thickness. That these huge and well-

armoured creatures, which might well be regarded as typical examples of animals fitted to withstand all enemies, have perished, while their smaller and less completely defended allies have lived on, indicates that there are other causes at work in the destruction of animals besides the attacks of foes. Between the plates of the armour of the armadillos hairs are always developed, and in one species these are so abundant as completely to hide the plates themselves, and render the general appearance that of an ordinary hairy mammal.

The chief use of hair is

to protect the body from cold, and thus to aid in the maintenance of a uniform high temperature; and when hairs are absent, we find this function performed by a more or less thick fatty layer beneath the skin, the layer, when excessively developed, as in whales, being known as blubber. To make up for the difference

between the temperature of winter and summer, many of the mammals which inhabit the colder regions of the globe develop a much thicker coat of hair in the former than in the latter season, of which we have an excellent example in the horse. In some mammals, such as the hare and cat, the body is covered with only one kind of hair; but in other cases, as in the fur-seals, there is one kind of long and somewhat coarse

hair, which appears at the surface, and another of a softer and finer nature, which forms the thick and warm under-fur. This under-fur is greatly developed in mammals of all groups inhabiting Tibet, where it is locally known as "pashm"; and it is this pashm of the goat of these regions which affords the materials for the celebrated Kashmir shawls. Curiously enough,

too, animals which usually do not develop pashm almost immediately tend to its production when taken to the Tibetan region, as is notably the case in the dog. Less frequently the hair of the body takes the form of stiff bristles, as in the pig; and still more rarely this thickening is carried to such an extent as to produce spines, of which we have the best instances

in the porcupine and hedgehog, belonging, it should be borne in mind, to distinct orders, the former being a rodent, while the hedgehog is one of the insectivora.

The solid horns of the rhinoceroses, and the hollow horny sheaths covering bony processes of the skull in cattle and antelopes, are very similar in their nature to hairs, and may indeed be compared to masses of hair welded into solid structures.

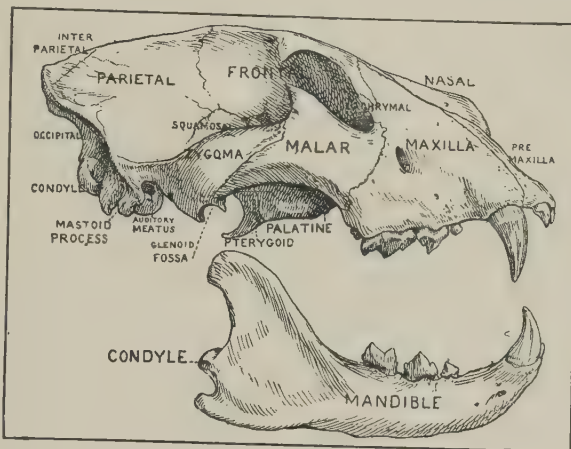
Although a fair idea of mammals as a whole may be gained without investigation into the nature of their soft internal parts, yet anyone who desires

to obtain really accurate knowledge of them must make up his mind to acquire at least some slight idea of the general structure of the bony skeleton, and also of the form and nature of the teeth, since these parts are of the highest importance in classification.

It has already been incidentally mentioned that

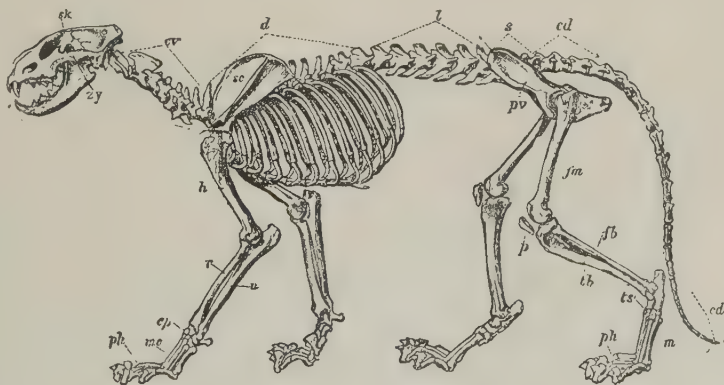
the skull consists of two portions—the skull proper, which contains the brain, and the lower jaw. It will suffice to mention, in addition, that the hind part of the skull is known as the occiput, and that on the front surface the pair of bones roofing over the cavity of the nose are known as the nasals, while those behind them, forming the region of the forehead, are termed frontals. Further, the bones in the upper jaw which

carry the hind, or cheek, teeth are known as the maxillæ, while those in which the front cutting teeth are implanted are termed the premaxillæ. All the other numerous bones of the skull have received distinct names; but the reader desirous of becoming acquainted with these must refer to one of the many excellent textbooks on anatomy.



SKULL OF THE LION

The mammalian skull, of which that of the lion is taken as a type, differs from that of the lower vertebrates, especially in having its parts more firmly welded together



SKELETON OF THE LION

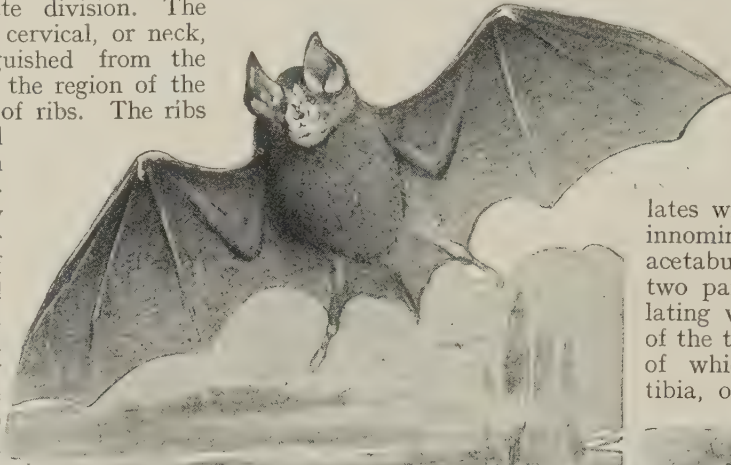
sk. skull; zy. cheekbone (zygomatic arch); cu. vertebræ of the neck; d. vertebræ of the back; l. vertebræ of the loins; s. sacrum; cd. vertebræ of the tail; sc. shoulderblade (scapula); h. armbone (humerus); r. u. bones of forearm (radius and ulna); cp. wrist (carpus); mc. metacarpus; ph. toe bones; pu. haunchbone (pelvis); fm. thighbone (femur); p. kneecap (patella); tb. fb. bones of lower leg (tibia and fibula); ts. ankle (tarsus); m. metatarsus

In the backbone, or vertebral column, the first vertebra, or the one which articulates with the skull, is known as the atlas; following this is the axis vertebra, which is remarkable for having attached to it the body or basal portion of the atlas vertebra, known as the odontoid process. This separation of the body of the atlas vertebra from its proper segment is constant throughout the greater part of the vertebrate division. The remaining five of the cervical, or neck, vertebrae, are distinguished from the dorsal, or vertebrae of the region of the chest, by the absence of ribs. The ribs of most of the dorsal vertebrae articulate in the middle line of the inferior aspect of the body with the breastbone, or sternum, which is itself composed of several segments. The dorsal vertebrae are succeeded posteriorly by a smaller number (forming the region of the loins) which have no ribs and are termed lumbar. Behind the latter are several coalesced vertebrae forming the so-called sacrum, to which the haunchbones, collectively constituting the pelvis, articulate; and these are again succeeded by the tail, or caudal, vertebrae, of which the number varies according to the length of the tail itself.

In the great majority of mammals the fore limb is connected on each side with the trunk simply by the bladebone, or scapula, which lies on the back surface of the anterior ribs; and, in front, by the collarbone, or clavicle, which connects the scapula with the sternum. The bones of the fore limb are, firstly, the armbone or humerus, which has condyles at its lower end; and, secondly, the two parallel bones of the fore arm, of which the outermost—when the palm of the hand is turned forwards—is the radius, and the other the ulna. The radius is always present, but in many hoofed mammals only the upper end of the ulna remains, which is fused with the radius. The radius articulates below with the upper of the two transverse rows of small solid bones forming the wrist or carpus; beyond these, we have in man and monkeys, as well as in certain other groups, five elongated bones, termed metacarpals, each of the

four outermost of which is succeeded by the three phalangeal bones of the fingers or digits. The thumb, or first digit, which lies on the same side as the radius, has, however, only two of these phalangeals.

The hind limb differs from the fore limb in that the innominate, or haunchbones, which together form the pelvis, are usually connected by an immovable bony union with the sacral region of the vertebral column. The thighbone, or femur, corresponding to the humerus of the arm, articulates with a cavity in the innominate termed the acetabulum. The leg has two parallel bones articulating with the lower end of the thighbone or femur, of which the larger, or tibia, occupying the inner



BAT AND JERBOA, ILLUSTRATING TWO EXTREMES IN THE DEVELOPMENT OF LIMBS

side of the limb, corresponds to the radius of the fore arm, while the smaller outer bone, or fibula, represents the ulna. The ankle, or tarsus, corresponds to the carpus in the fore limb, and likewise consists of two transverse rows of small bones. Two bones of the uppermost row, namely, the calcaneum or heelbone, and the astragalus or hucklebone (the uppermost bone of the ankle), are specially modified. In the foot proper the bones correspond with those of the hand; those representing the metacarpals being, however, termed metatarsals. In the course of this work it will frequently be found convenient to speak of the extremity of the fore limb, or hand, as *manus*; while the hind foot may be termed *pes*.

In the foregoing summary we have spoken of the hand and foot as consisting of five fingers and toes, or digits; and this is the case in most monkeys, many carnivora, rodents, etc. In other cases, however, and especially among the hoofed mammals or ungulates, there is a tendency to the reduction of the number of digits. Thus, in cattle and deer, commonly known as ruminants, the number of functional digits is reduced to two, corresponding to the third and fourth of the typical series of five, while in the horse only a single digit remains, which in the fore limb corresponds to the middle or third finger of the human hand, and in the hind limb to the middle toe.

Almost all mammals when adult have both jaws provided with a series of teeth, varying greatly in number and structure in the different groups. These teeth are almost invariably fixed in separate sockets, and, while each of the front teeth has only a single root or fang, the side or cheek teeth very generally have two or more such roots, each of which occupies a separate division of the socket. In all



THE MUSK-OX, WHOSE HAIRY COAT IS ADAPTED TO THE ARCTIC REGIONS

cases the teeth are fixed in their sockets merely by the aid of soft tissues connected with the gum, and are never welded to the jaws by a deposit of bone. Very generally there is a sharply-marked line of division, termed the neck, between the root, or portion of the tooth implanted in the jaw, and the crown or exposed portion.

In most of those mammals in which the teeth of different parts of the jaw differ in structure from one another, there are two distinct sets of teeth developed during life. The first of the two includes the milk or baby teeth, which are generally shed at a comparatively early age, are of small size and few in number, and are finally succeeded by the larger and more numerous set which remains during the rest of life, unless previously worn out.

In those mammals in which the permanent teeth differ from one another in form in different regions of the jaw, we are enabled from their position, and also from their relations to the temporary series of milk teeth, to divide them into four distinct groups. Taking one side of the upper jaw, as that



THE PORCUPINE, IN WHICH SOME OF THE HAIRS HAVE BECOME QUILLS

of the wolf, of which the teeth are shown in the annexed figure, we find the front bone, or premaxilla, carrying a small number (in this instance three) of simple cutting teeth, termed incisors. Behind these teeth, from which it is generally separated by a longer or shorter gap, there is a tooth with a simple and often conical crown, which, like the incisors, is inserted in the jaw by a single root. This tooth, which is usually larger than the incisors, is termed the tusk, or canine tooth, and in the wild boar and most carnivorous mammals attains a very large size. It can always be distinguished from the incisors by the fact that it is implanted in the maxilla, or second bone of the jaw, or at least, on the line of junction between that bone and the premaxilla. Behind the canine comes a series of teeth, which may be as many as seven, although only six in the wolf, with more complicated crowns, and, except the first, inserted in the jaw by two or more roots. This series is collectively known as the cheek teeth, but they are divided into two minor groups according as they are preceded by milk teeth or not. In the wolf the four teeth immediately behind the canine, with the exception of the first, are the vertical successors of milk teeth, and are known as premolars; while the two hindmost teeth, which have no such temporary predecessors, are termed true molars, or molars. In the lower jaw the tooth, usually larger than the others, which bites in front of the upper canine is the lower canine. In advance of this tooth are the incisors, and behind it the premolars and molars, distinguished from one another in the same manner as are the corresponding teeth of the upper jaw. With the exception of the pouched mammals (marsupials), there are, in practically all the mammals with teeth of different kinds, never more than three incisors, one canine, four premolars, and three molars on each side of each jaw, so that the total number of teeth on both sides of the two jaws is not more than forty-four. In the figured upper jaw of the wolf the number falls short of this full complement, owing to the circumstances that there are only two in place of three molars.

As it is inconvenient always to have to describe the number of teeth in any given mammal by writing them down at length, a graphic formula has been invented by which the number of teeth of each species can be shortly and clearly expressed. Thus, taking only one side of each jaw, and indicating the incisors by the letter *i*, the canines or tusks by *c*, the premolars by *p*, and the molars by *m*, and taking the number above the line as representing the teeth of the upper, and those below the teeth of

the lower jaw, we may state the number and kinds of the teeth of the wolf by the formula: $i\frac{3}{3}, c\frac{1}{1}, p\frac{4}{4}, m\frac{2}{3}$. The total thus given is 21, and double this shows the number of teeth on both sides of the two jaws, which in this case is 42.

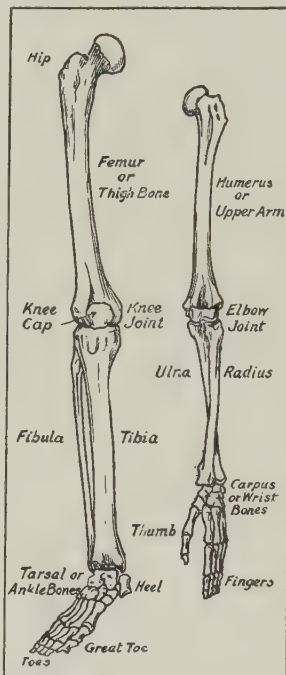
A few words must be said regarding the internal structure of teeth, as without some knowledge of this it is impossible to understand the modifications which they undergo in different groups of mammals. Taking a simple more or less conical tooth like the tusk of a lion or tiger, or any tooth of a sperm-whale, it may be observed that when such a tooth first appears above the gum it is open at the base, where it forms a hollow cone. And in teeth like the tusks of the elephant, which grow throughout the whole life of their owner, such a condition remains permanent. Usually, however, a tooth ceases to grow after a certain period, and the base of the root or roots then becomes completely closed, and assumes a pointed shape. A tooth of this simple conical type is composed internally of a substance known as the ivory, or dentine, generally coated externally with a thin layer of a much harder nature and having a highly polished appearance, which is termed the enamel. Moreover, outside the base of the crown there may be patches of a coarser substance, called the cement. In order that its structure may be readily understood, a model of such a

tooth may be made by taking the finger of a kid glove, filling it with beeswax, and putting some smears of sealing wax at the base of the outer surface, when the beeswax will represent the ivory, the kid the enamel, and the sealing wax the cement. If we then cut off the summit of the finger we shall have a central disc of beeswax (ivory) surrounded by a circle of kid (enamel), which will represent the condition of such a type of tooth when its summit

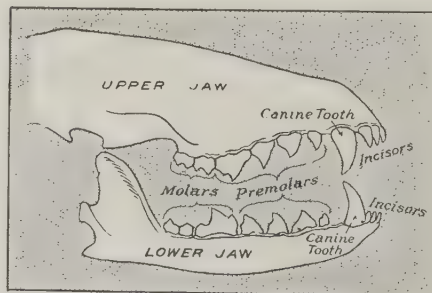
has been worn away by friction against the opposing tooth of the opposite jaw. If, however, before cutting off the end of our model, we indent the summit with several deep pits, and also mark the sides with one or more grooves, and fill up such pits and grooves with sealing wax, it will be obvious that we shall have a much more complex type of structure. This complex model will serve to explain the type of tooth-structure found in

many of the hoofed mammals; and it will be obvious that if we now cut off the summit of our model we shall find a series of irregular discs of beeswax (ivory), each surrounded by a sinuous border of kid (enamel), in the folds of which will be masses of sealing wax (cement).

R. LYDEKKER



HUMAN LEG AND ARM BONES COMPARED



THE DENTITION OF A WOLF

THE EVOLUTION OF MAMMALS

WITH A TABLE OF THEIR CLASSIFICATION

By R. LYDEKKER

As regards the origin of mammals, it is now practically certain that the class is descended from a group of extinct reptiles known as the Anomodontia, or Theromorpha, of which the remains occur in great abundance in the Triassic or lowest Secondary strata of South Africa, Russia, and certain other countries. The members of one section of these anomodonts were carnivorous reptiles, with teeth divided into incisors, canines, and cheek teeth, after the mammalian pattern, and also implanted in distinct sockets in the lower jaw. Some of these theriodonts, as they are called, were of great size, rivalling in this respect wolves and leopards; but it must have been from the species of the size of opossums that mammals are descended. The resemblance between these early theriodont reptiles and mammals is not confined to the teeth, the skull exhibiting a number of mammalian features, especially as regards the small size of the quadrate, by which, as mentioned already (page 137), the lower jaw of reptiles is articulated to the skull itself. The quadrate bone of the theriodonts is, in fact, on the point of vanishing, and there may some day be discovered one of these reptiles in which it has actually disappeared. When such a specimen turns up, it will be almost impossible to say whether its owner was a reptile or a mammal; and, indeed, we are already acquainted with one skull from South Africa which has been referred by some naturalists to a reptile, and by others to mammals.

The shoulder-girdle and the pelvis of all the anomodont reptiles are strikingly like those of the egg-laying mammals, or monotremes; so that there can be no doubt as to the direct descent of the latter from the former. Unfortunately, the existing representatives of the egg-layers have either completely lost their teeth, or develop only a few of a highly specialised character while young; and it is therefore impossible to say whether any member of the group had a dentition like that of the theriodonts. If not, it may be that the egg-laying mammals were derived from anomodonts independently of other mammals.

In all anomodonts the skeleton of the limbs is of an essentially mammalian type.

In all likelihood the evolution of mammals from

the theriodont reptiles took place in Southern Africa, which is known to have existed as dry land since a very early period of the earth's history. And, apart from the egg-laying group, there is a probability that the early Tertiary group of extinct Carnivora known as creodonts is nearly related to the ancestral stock of ordinary mammals.

Many of these creodonts have the crowns of the cheek teeth surmounted by three cusps arranged in a triangle, as shown in the lower jaw figured on this page; this tritubercular type of molar, as it is called, which persists in its simplest form among recent mammals only in certain groups of insectivora, such as the African golden moles, being common to the early members of many of the mammalian order.

Whether or no the aforesaid creodont carnivora are or are not the direct descendants of the theriodont reptiles, they are certainly a very ancient type. Their dentition presents many resemblances to that of the carnivorous marsupials; but it seems probable that this is not indicative of near relationship.

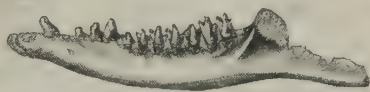
The creodonts are, however, known to have given rise to certain extinct whale-like mammals termed zeuglodonts; and if, as seems on the whole probable, these zeuglodonts are related to whales, the latter must also have originated from primitive Carnivora.

The other group of exclusively aquatic mammals, namely, the Sirenia, as represented by the existing manati and dugong as well as by a number of extinct kinds, are now known to be intimately related to the ancestors of the elephant group, or Proboscidea, so that both are evidently divergent branches of a single stock.

As to elephants themselves, discoveries in the early Tertiary strata of the Fayum district of Egypt have shown them to be descended from animals which depart comparatively little from the early type of hoofed mammals.

Indeed, as we descend in geological time, we find the ancestral forms of nearly all the orders of land mammals approximating more or less markedly to a common type, so that there can be no doubt as to their having originated from one stock, although it is at present impossible to point out their precise relationships to one another.

Although commonly placed high up in the series,



THE LEFT HALF OF THE LOWER JAW OF AN EXTINCT POUCHED MAMMAL



THE GOLDEN MOLE

the insectivora are evidently mammals of a very low type, with a possible relationship to marsupials.

Numerous as are the species of mammals now living, it must never be forgotten that they form but a small portion of those which flourished at earlier periods of the history of our earth. The mammals of the present day may, indeed, be com-

Mammals and Birds. We are not, however, to suppose from this that mammals were unknown before the Tertiary period, a considerable number of species, mostly of small size, having been already discovered in various strata of the Secondary period.

An additional importance attaches to the study of extinct mammals, since it is by their means alone that we are able to explain several apparent anomalies in the geographical distribution of living groups. It would, for instance, be impossible to explain the present existence of tapirs only in such widely remote areas as the Malay Peninsula and Islands, and South America, unless we had learnt by geological explorations that these animals formerly roamed over large portions of Europe and Asia, whence their descendants gradually migrated to the regions where they now remain.

The former occurrence of an epoch of great cold in the Northern hemisphere, known as the Glacial period, explains

how nearly related animals are now confined to isolated mountain chains; their ancestors having been enabled, during the prevalence of the cold, to spread over the plains of the temperate regions, whence they retreated with the advent of warmer conditions to seek a congenial climate in the nearest mountain region.

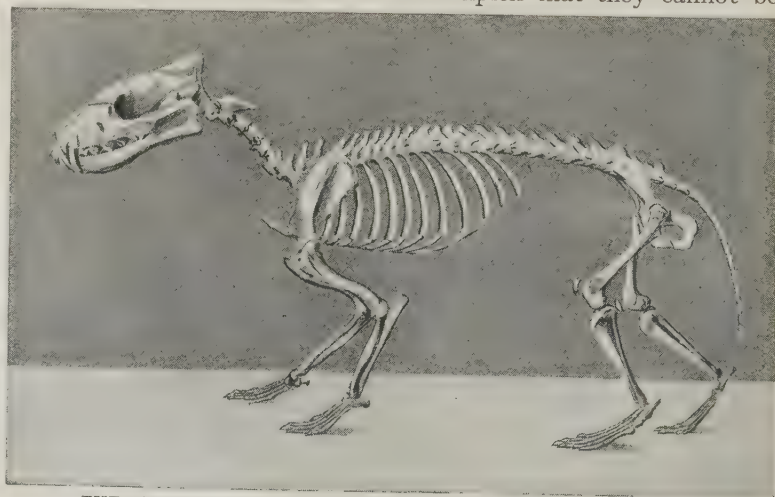
The mutual relationships of the different groups of mammals are so complex that they cannot be

pared to the topmost branches and twigs of a giant forest tree, of which the larger limbs and trunk are concealed from our view; and it will accordingly be manifest that anyone who confines his studies to the existing species will have but a very imperfect idea of the whole array of mammalian life, and of the mutual connection of its various branches. The study of fossil mammals is, however, very difficult, and one requiring an extensive knowledge of comparative anatomy. All, therefore, that can be done is to direct attention, as occasion arises, to some of those extinct mammals which are of especial importance and interest as showing the manner in which groups now widely separated from one another were formerly more or less completely connected.

Although the number of extinct mammals is very large, yet the greater proportion of these belong to the latest of the three great epochs into which the geological history of our globe has been divided. During the long-past epoch known as the Secondary period, during which the Chalk and Oolites were deposited, the earth was tenanted by gigantic reptiles of strange form, and it is not till we come to the rocks above the Chalk—such as the London Clay and the overlying strata—that we find mammals taking an important place among the inhabitants of the earth. It was, indeed, during this Tertiary period that these animals attained the dominant position which they now occupy; and the present stage of the earth's history may be truly called the Age of



THE SKELETON OF A MAMMAL-LIKE REPTILE, THE PAREIASAURUS
A gigantic land-reptile in which many mammalian features are to be found



THE SKELETON OF A HYÆNODON, AN EARLY CARNIVORE
The relatively large and heavy skull is a notable feature

represented by any system of linear classification, and a tree-like diagram would be the only method of properly displaying these relationships. But since it is impossible to give such a genealogical tree with any certainty, we are driven to the linear arrangement, as in the following table of the existing orders and families.

R. LYDEKKER

CLASS I.—MAMMALIA

SUBCLASS I.

Viviparous Mammals (Eutheria, or Vivipara)

SECTION A.

Placentals (Placentalia)

ORDER I.

Man, Apes, Monkeys, Lemurs

Primates

SUBORDER I.—Man, Apes, Monkeys

Anthropoidea

FAMILY

1. Man Hominidæ
2. Man-like Apes Simiidæ
3. Old World Monkeys and Baboons Cercopithecidæ
4. American Monkeys Cebidæ
5. Marmosets Hapalidæ

SUBORDER II.—Lemuroids

Lemuroidea

FAMILY

1. Lemurs Lemuridæ
2. Aye-aye Chiromyidæ
3. Galagos and Lorises Lorisidæ
4. Tarsier Tarsiidæ

ORDER II.

Bats

Chiroptera

SUBORDER I.—Fruit-eating Bats

Megachiroptera

FAMILY

1. Flying Foxes Pteropodidæ

SUBORDER II.—Insect-eating Bats

Microchiroptera

FAMILY

1. Horseshoe Bats Rhinolophidæ
2. False Vampires Nycteridæ
3. Typical Bats Vespertilionidæ
4. Free-tailed Bats Emballonuridæ
5. Vampires Phyllostomatidæ

ORDER III.

Insect-eating Mammals

Insectivora

SUBORDER I.—Flying Lemurs

Dermoptera

FAMILY

1. Cobegos, or Kaguans Galeopithecidæ

SUBORDER II.—Tupais and Jumping

Shrews .. Typhlomena

FAMILY

1. Tupais Tupaiidæ
2. Jumping Shrews Macroscelididæ

SUBORDER III.—Shrewmice, etc.

Insectivora vera

FAMILY

1. Hedgehogs, etc. Erinaceidæ
2. Shrewmice Soricidæ
3. Moles Talpidæ
4. Tenrecs Centetidæ
5. Solenodons Solenodontidæ
6. Otter-Shrews Potamogalidæ
7. Golden Moles Chrysochloridæ

ORDER IV.

Flesh-eating Mammals

Carnivora

SUBORDER I.—Typical Carnivora

Fissipedia

FAMILY

1. Cat tribe Felidæ
2. Civets and Mongooses Viverridæ
3. Hyænas Hyænidæ
4. Aard-Wolf Proteleidæ
5. Wolves, Dogs, Foxes Canidæ
6. Bears Ursidæ
7. Raccoons and Pandas Procyonidæ
8. Weasel tribe Mustelidæ

SUBORDER II.—Eared Seals, Walrus, Seals

Pinnipedia

FAMILY

1. Sea Lions and Sea Bears Otariidæ
2. Walrus Odobænidæ
3. Typical Seals Phocidæ

ORDER V.

Rodents, or Gnawing Mammals

Rodentia

SUBORDER I.—Squirrels, Mice, etc.

Simpleidentata

FAMILY

1. Scaly-tails Anomaluridæ
2. Squirrels and Marmots Sciuridæ
3. Beavers Castoridæ
4. Sewellels Haplodontidæ
5. Dormice Myoxidæ
6. Jerboas Dipodidæ
7. Mice and Rats Muridæ
8. Gundi, Degu, etc. Octodontidæ
9. Porcupines Hystricidæ
10. Chinchillas and Viscachas Chinchillidæ
11. Agutis and Pacas Dasyproctidæ
12. Cavies Caviidæ

SUBORDER II.—Hares, Rabbits, Picas

Duplicidentata

FAMILY

1. Picas Lagomyidæ
2. Hares and Rabbits Leporidæ

ORDER VI.

Hoofed Animals

Ungulata

SUBORDER I.—Even-toed Group

Artiodactyla

1. Cattle, Sheep, Antelopes, Deer, and Giraffes Pecora

FAMILY

1. Cattle, Sheep, and Antelopes Bovidæ
2. Prongbuck Antilocapridæ
3. Giraffes and Okapi Giraffidæ

B. Camels and Llamas

Tylopoda

FAMILY

1. Camels and Llamas Camelidæ

FAMILY

1. Chevrotains Tragulina

FAMILY

1. Chevrotains Tragulidæ

FAMILY

1. Pigs Suidæ
2. Peccaries Dicotylidæ
3. Hippopotamuses Hippopotamidæ

SUBORDER II.—Odd-toed Group

Perissodactyla

FAMILY

1. Tapirs Tapiridæ
2. Rhinoceroses Rhinocerotidæ
3. Horse tribe Equidæ

SUBORDER III.—Hyraxes

Hyracoidea

FAMILY

1. Hyraxes Hyracidæ

SUBORDER IV.—Elephants

Proboscidea

FAMILY

1. Elephants Elephantidæ

ORDER VII.

Manatis and Dugongs

Sirenia

FAMILY

1. Manatis and Dugongs Halicoridæ

ORDER VIII.

Whales and Dolphins

Cetacea

SUBORDER I.—Whalebone Whales

Mystacoceti

FAMILY

1. Whalebone Whales Balænidæ

SUBORDER II.—Sperm Whales and Dolphins

Odontoceti

FAMILY

1. Sperm Whales Physeteridæ
2. Beaked Whales Ziphiidæ
3. Susu Platanistidæ
4. American River Dolphins Iniidæ
5. Porpoises and Dolphins Delphinidæ

ORDER IX.

Sloths, Armadillos, etc.

Edentata

FAMILY

1. Sloths Bradypodidæ
2. Ant-eaters Myrmecophagidæ
3. Armadillos Dasypodidæ
4. Pangolins Manidæ
5. Ant-Bears Orycteropodidæ

SECTION B.

Pouched Mammals (Implacentalia)

ORDER X.

Marsupials

Marsupialia

FAMILY

1. Kangaroos and Wallabies Macropodidæ
2. Cuscuses and Phalangiers Phalangeridæ
3. Wombats Phascologyidæ
4. Selvas Epanorthidæ
5. Bandicoots Peramelidæ
6. Tasmanian Wolf, etc. Dasyuridæ
7. Opossums Didelphyidæ

SUBCLASS II.

Egg-laying Mammals (Hypotheria, or Ovipara).

ORDER XI.

Platypus and Echidnas

Monotremata

FAMILY

1. Spiny Ant-eaters Echidnidæ
2. Platypus, or Duckbill Ornithorhynchidæ

TYPES OF THE CHIEF LIVING RACES OF MANKIND



The Negroid races shown in this picture are : 1, Bushman ; 3, Negro ; 5, Zulu. The Mongolian races are : 2, Australian Aboriginal ; 4, Maori ; 6, Red Indian ; 7, Japanese ; 9, Chinese ; 10, Eskimo. The Caucasian races are : 8, Hindu ; 11, Turk ; 12, Persian ; 13, Greek ; 14, Russian ; 15, Jew

MAN THE SUPREME MAMMAL

HOW HE BECAME THE HEAD OF THE ANIMAL KINGDOM

By J. ARTHUR THOMSON, M.A.

Regius Professor of Natural History, Aberdeen University

ZOOLOGICALLY considered, man is a mammal, bound to other mammals by an "all-pervading similitude," to use Sir Richard Owen's phrase, in structure, in function, and in development. At the same time, he is worthy of being called the supreme mammal, so highly is he specialised in body and brain; and he shows a number of distinctive features, or what we may call human characteristics.

Man alone, after his infancy is past, walks quite erect—a thorough-going biped. Though his head is weighted with a heavy brain, it does not droop forwards on the chest. Dr. Robert Munro and others have given strong reasons for correlating the upright attitude with the increased command of the vocal mechanism. Playful reference is often made to the absence of a tail in man, but in this reduction the anthropoid apes have gone even farther. In the human skeleton there are four or five obvious caudal vertebræ, which fuse together to form what is called the coccyx. In young embryos there is a short projecting portion surrounded by skin, and this sometimes persists after birth as a distinct tail. The sparseness of well-developed hairs over the body is also distinctive, but there is great variability in this respect in different individuals and races. Darwin was inclined to interpret the relative nakedness of man as due to some extent to a warm climate, but in greater part to sexual selection, the less hairy men and women having selected one another for æsthetic reasons.

Both the fore limbs and hind limbs have undergone modification in adjustment to man's erect walk. It is evident that when the bipedal position was attained, and the hand liberated from any share in locomotion, the human foot was bound to develop a steady but flexible sole. Thus there is something distinctive even in the way man plants his foot on the ground, with the whole sole flat. The great toe is often longer, never shorter, than the others, and lies in the same line with them. There is a better heel than in any monkey. It used to be the custom to contrast man and monkeys as *Bimana* and *Quadrumana* respectively, but there is very little in this distinction. For although all monkeys have an "opposable" great toe, or hallux, which they use against the other toes in grasping things in a way that is not possible to man, the value of the contrast diminishes when we note that some wild peoples are able to grip with their toes, and that babies show a marked power of "opposability" that is afterwards lost.

When we compare the human skull with an ape's, we see that man has more of a true forehead rising above the eyes, a less protrusive face—not less, however, than some American monkeys—smaller

cheekbones and supraorbital ridges, no crests for the attachment of muscles on the top or back of the head, projecting nasal bones above the nostril, an early disappearance of the junction between the premaxillary bones (that bear the four front teeth, or incisors) and the maxillary bones (that bear all the other teeth), a true chin or bony process at the anterior junction of the two halves of the lower jaw, and much more uniform teeth, forming an uninterrupted horseshoe-shaped series without very conspicuous canines. At the same time, it must be remembered that there is considerable variability among men in regard to these characters; thus the ridges over the eyes are much more strongly marked in some people than in others, the cheekbones differ greatly in their degree of prominence, and so on.

Compared with most monkeys, man has longer legs and shorter arms, and there are other minor differences that might be mentioned. Of enormously greater importance are the differences in cranial capacity and weight of brain. "The cranial capacity is never less than 55 cubic inches in any normal human subject, while in the orang-utan and chimpanzee it is but 26 and 27½ cubic inches respectively." The brain of a healthy human adult never weighs less than 31 or 32 ounces; the average human brain weighs 48 or 49 ounces; the heaviest gorilla brain does not exceed 20 ounces. A man *may* have a brain three times as heavy as that of a gorilla.

Like many other mammals, man shows a noteworthy degree of sex-dimorphism—that is to say, there is a marked difference in the detailed characters of man and woman. The typical female form, compared with the typical male form, shows a relatively longer trunk, shorter arms, legs, hands, and feet—"relatively to short upper arms, still shorter forearms, and relatively to short thighs, still shorter lower legs, and relatively to the whole short upper extremity a still shorter lower extremity"—all pointing to a less actively locomotor type. Man is, on an average, heavier, taller, more muscular, shorter-lived, and so on; but the important fact from the biological point of view is that the fundamental sex difference saturates, as it were, through the organism, expressing itself in large features, such as the proportions of different parts of the body, and in minute details, such as the number of red blood corpuscles.

The large and complex brain of man is correlated with those differences which everyone admits to be most distinctive: (1) That he has a power of working with abstract ideas, making "conceptual inferences," exercising *reason*; (2) that he has the habit of guiding his conduct in reference to certain ideals, exerting, when he will, a power of

ethical choice, "*thinking the ought*"; and (3) that he has a language in the true sense, a power of expressing his judgments in a manner intelligible to others, which is something more than having words, being, in short, a *logos*.

Darwin was not sanguine of discovering a cause for the intellectual stride which marked the emergence of man; he gave more attention to showing, by his observations on dogs and the like, that, even in regard to reason—or conceptual inference—there are no sharply defined limits between the mental powers of man and animals. In regard to morality, he showed that the raw materials were present in animal behaviour, especially among social and gregarious species. The same fundamental springs of conduct, such as family affection and kin-sympathy are there, and in some cases there is a deliberation which is a foretaste of conscience. But the power of speech was required to develop public opinion, which has so much to do with morals.

In regard to language, Darwin pointed out that various mammals and birds have particular sounds with distinctive significance, and that sheep-dogs can understand a complex order which their master gives. "I cannot doubt," he said, "that language owes its origin to the imitation and modification of various natural sounds, the voices of other animals, and man's own instinctive cries, aided by signs and gestures." But its development went hand in hand with that of intelligence, and "the fact of the higher apes not using their vocal organs for speech no doubt depends on their intelligence not having been sufficiently advanced"—a view which agrees with what a modern psychologist has said, that animals would speak if they had anything to say.

MAN'S AFFILIATION

Darwin's "*Descent of Man*" (1871) is an expansion of a chapter in his "*Origin of Species*" (1859), for the argument which leads to the conclusion that man arose from an ancestral stock common to him and to the higher apes is logically the same as that which leads to the general doctrine of descent—that the present is the child of the past and the parent of the future. The heads of the familiar argument may be indicated:

(1) *As to Structure*.—Bone for bone, organ for organ, man is very like one of the anthropoid apes. Even in such a trivial detail as the arrangement of the hair in different parts of the body, man is dis-

tinctly simian. Some of the anatomical differences have been already indicated, but the only very important one is the large and heavy brain. As Huxley proved in his famous book, "*Man's Place in Nature*" (1863), the structural differences between one of the lower monkeys, such as the marmoset, and the chimpanzee are much greater than those between the chimpanzee and man. Furthermore, as



SKELETONS OF MAN AND THE GORILLA

These skeletons show how man differs from the gorilla in the length of arms and legs and form of the skull

we shall see later, man is a walking museum of relics—vestigial structures—in his muscular, skeletal, and other systems, which are quite enigmatical except when interpreted as dwindling items in a complex mammalian heritage. In a very literal sense, he is heir of all the ages. Many of the occasional abnormalities of structure in man have a very interesting historical interest, throwing light on his pedigree. Thus, Testut, one of the greatest authorities on such matters, says of the muscles that "the gap which usually separates the muscular system of man from that of the anthropoids appears to be completely bridged over" by the abnormalities.

(2) *As to Functions and Habits*.—The bodily life of man is very like that of his presumed relations. Some peculiar "idiosyncrasies" that now and then assert themselves seem like outcrops of the pre-human. Various features of physiognomy and trivial details of gesture are paralleled among the apes. Men and monkeys are subject to similar diseases, such as rheumatism and phthisis.

One of the most interesting additions to the list of resemblances has to do with the blood. Let us take it first in its simplest form. Friedenthal has shown that when the blood of a cat is transfused into a rabbit it exerts a destructive influence, dissolving the red blood corpuscles. But when the blood of a horse is mixed with that of an ass, or a dog's with a wolf's, there is no destruction of corpuscles, and this is a sign of near relationship. Friedenthal found that this held good for man and chimpanzee.

This matter has been worked out by a number of investigators, Tschistowitsch, Uhlenhuth, Nuttall, and Friedenthal. If a rabbit, for instance, has repeated injections of blood serum from another *unrelated* kind of animal, it reacts to the foreign material by forming and accumulating in its blood a substance which, when added to a solution of the serum injected, gives rise to a precipitate. When human blood has been injected into a rabbit, the serum of this rabbit forms a precipitate when added to human blood. When added to the blood of an anthropoid ape, like the orang-utan, it gives a

similar precipitate, but this is weak in the case of the more distantly related Old World monkeys, and practically absent in the very remotely allied New World monkeys. When added to the blood of a horse or the like, there is no reaction. There is a common property in the blood of related forms; in short, *blood-relationship* is a literally accurate term. "We have in this," as Prof. Schwalbe says, "not only a proof of the literal blood-relationship between man and apes, but the degree of relationship with the different main groups of apes can be determined beyond possibility of mistake." There are some anomalies, but most of the results correspond closely with the conclusions of comparative anatomy. Thus, according to the blood-tests, the ass is considerably nearer to the horse than the orang-utan is to man.

(3) *As to Racial History and Individual Development.*—Remains of primitive man are few and fragmentary, and though it must be granted that some of the early skulls are nearer the simian type than those normal to-day, we have more security in dealing with individual development than with racial history. There is a close resemblance between the unborn human child and the corresponding stage in the development of one of the anthropoid apes.



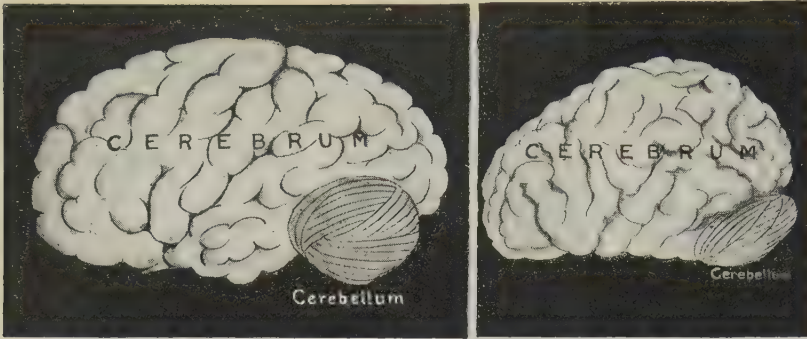
THE APOLLO BELVEDERE, IN THE VATICAN
An ideal type of manly beauty. Photo. by Anderson, Rome



THE VENUS OF MILO, IN THE LOUVRE
The highest ideal type of woman. Photo. by W. E. Mansell & Co.

Not only is there a general likeness, but there are several trivial resemblances that are even more convincing. Thus, the human embryo, about the middle of the ante-natal period, has a pointed ear, somewhat similar to that of a macaque monkey, and this animal ear-point is sometimes quite clearly seen in adult men. Children born in untoward conditions, after a siege or a famine, are sometimes below the ordinary human level; and apart from such cases of arrested development there are a few instances of what seems most reasonably interpreted as a structural harking-back to a pre-human stage.

In man, as in other types of animal life, we find that the development of the individual recapitulates in a general way the historical evolution of the race. This is best illustrated in the parallelism sometimes observable in regard to particular organs between stages in embryonic development and stages in presumed ancestral evolution. Thus, it is noteworthy that the unborn human offspring shows a hairy coat, or lanugo, a short projecting tail, arms as long as legs, and other characters which point to a quadrupedal, tailed, hairy ancestor. Similarly, the newly-born baby shows peculiarities which seem to be more than the results of its adaptation to the conditions of the ante-natal life. Thus, we may refer to the mobility of the feet and of the individual toes, and to the extraordinary power of gripping and hanging on with the fingers.



THE BRAIN OF MAN AND THE GORILLA COMPARED

It is in the development of the brain that man's superiority over the ape is most characterised, as the size and number of the convolutions show

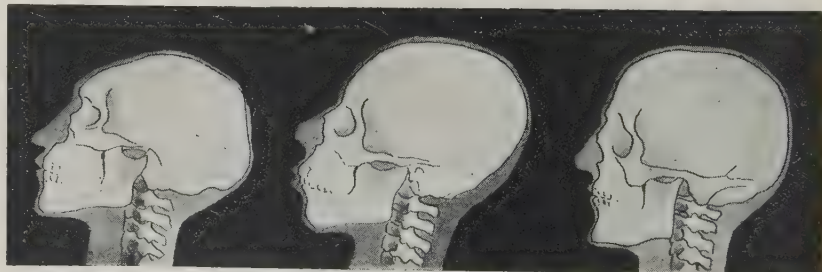
There are four genera of anthropoid apes—gibbon, orang-utan, gorilla, and chimpanzee—and, as Huxley pointed out, each has its particular points of resemblance with man, while each is specialised along a line of its own. In this connection it is important to notice how the generally accepted conclusion that man has arisen from a stock common to him and to the anthropoid apes is borne out by embryology. We may illustrate this with reference to the gibbons, which approach man in many ways, not only in sociality and vocal powers, but in numerous structural details; for instance, in regard to the teeth. Yet the gibbons are highly specialised for climbing, and have disproportionately long arms almost reaching the ground. There is at once marked resemblance and marked difference, but the particularly instructive fact is that worked out by Selenka, that up to a certain point there is a very striking resemblance between the gibbon embryo and the human embryo, and for a considerable time the gibbon embryo has its fore limbs and hind limbs in their usual proportions. Human embryo and gibbon embryo travel for a time side by side on parallel paths of development, but eventually each takes a way of its own.

Thus, whether we consider finished structure; or functions and habits, or the facts of development, we find so many strong resemblances between man and the anthropoid apes that it seems impossible to doubt that there is a real blood-relationship. They and he must be regarded as offshoots from a common stock. The structural affinities are so numerous, again, that we must reject the view that man has evolved "parallel with the monkeys, but without relation to them, from very low primitive forms." The zoological evidence clearly points to the conclusion that the divergence of man from the anthropoids occurred after the divergence of the common stock from the Old World monkeys (Catarrhini) in general. As Darwin said: "The Simiidae branched off into two great stems, the New World and the Old World monkeys; and from the latter, at a remote period, man, the wonder and glory of the universe, proceeded."

Darwin compared rudimentary (or, better, vestigial) organs to the unsounded letters in words, such as the "o" in leopard and the "b" in doubt, which have only a historical interest, having ceased to be functional. We see the same sort of "survival" every day in our clothing; for instance, in various functionless buttons and unopenable buttonholes, and illustrations abound in social institutions. The general idea is that the vestigial structures—whether bones or buttons, letters or offices—are dwindling residues of what

were once of functional importance, and man's body is a veritable storehouse of such relics.

(I.) It is useful to distinguish, first of all, those antique structures which are present only in the embryo, and do not normally come to anything in the adult. Thus, to take one of the most familiar cases, there are on each side of the neck of the human embryo four clefts from the pharynx to the exterior—the visceral clefts or branchial clefts. They are present in the embryos of all reptiles, birds, and mammals, but only the first of them has any functional import. It becomes the Eustachian tube passing from the ear-opening to the back of the mouth. The others normally disappear without leaving a trace. There is no doubt as to the historical significance of these visceral clefts; they represent the gill clefts which persist throughout life in fishes, and are associated with gills. Amphibians represent a transition stage, for there the first gill cleft becomes for the first time the Eustachian tube in the service of the ear; and the other clefts, though provided with gills and used in respiration in tadpoles and other larval stages, often disappear entirely in adult life. To pursue the inquiry one step farther, it is interesting to find that a not very infrequent abnormality in man is the presence of a "cervical auricle" on the side of the neck—a persisting vestige of a posterior gill cleft which has not wholly disappeared in embryonic life. It may take the form of a minute aperture, or it may show a small flap like a hint of an external ear. Similar cervical auricles are occasionally seen in horses, goats, and other mammals. In further illustration of embryonic vestigial organs, we may

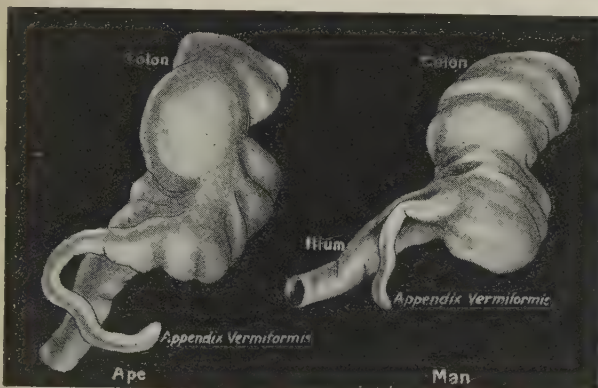


THE DIFFERENCES BETWEEN THE SKULLS OF LIVING RACES OF MAN

These pictures show how the skull of man has evolved. The first is that of an Australian native, a low type; the second that of a Negro; and the third that of a European, the highest type

MAN, THE SUPREME MAMMAL

notice (1) the transitory notochord which precedes the backbone, and is reminiscent of the permanent dorsal axis in old-fashioned primitive vertebrates like the lancelet and the lamprey; (2) the primitive, soft woolly covering, or lanugo, on the body of the unborn child, which occasionally persists in adult life in one of the kinds of exuberant hairiness—to be distinguished from other kinds where the hairs are not of the lanugo type; (3) the occurrence of ribs in connection with vertebræ which have none in the adult, the vertebræ supporting the hip girdle, the vertebræ of the loins, and the sixth and seventh neck vertebræ, the last occasionally persisting in the adult. Besides these vestiges there are many others, especially in connection with the muscular, skeletal, and vascular systems, a careful account of which will be found in Wiedersheim's remarkable treatise, "The Structure of Man." One caution must be emphasised: that it is beyond our knowledge to deny utility to all of these vestigial embryonic structures. Some of them, such as the transient notochord, may have some architectural significance, serving,



THE VERMIFORM APPENDIX IN MAN AND THE GORILLA

The difference between the appendix in man and the ape is well shown in the diagram. The organ has become atrophied in the human intestine, and its inflammation is a well-known source of mischief

perhaps, as a preliminary scaffolding for its more effective substitute—the backbone.

(II.) In a second grade we may place those structures which persist in adult life, but in a much disguised form. The intergrade between the two sets of cases is the first gill cleft, which becomes the Eustachian tube and tympanic cavity. In the same way, the gill arches, whose primary significance was to support gills, are in part persistent in the skeletal support of the mammalian tongue (the hyoid) and in the framework of the larynx (Adam's apple). Very striking, but more difficult to state in a few words, is the extraordinary way in which antique arrangements persist in disguised form in the vascular system, now and again revealing their historical significance by some tell-tale variation, such as the occurrence of a double aortic arch. The arteries leaving the heart of the human embryo are disposed as paired aortic arches going to the visceral clefts, as in a fish or a tadpole; and in a very remarkable way the dorsal aorta (to the body) is derived from what corresponds to the second branchial

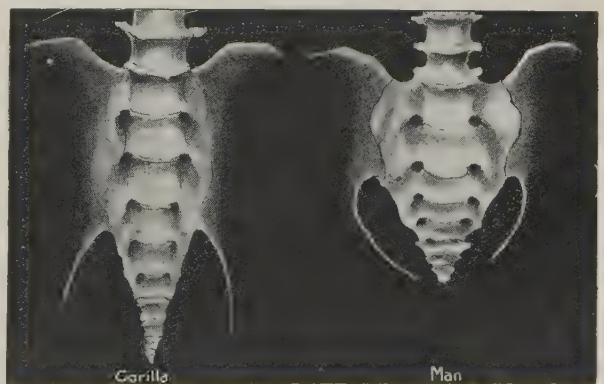


THE MOLAR TEETH OF MAN AND THE GORILLA

There is the same number of teeth in man and the man-like apes, and, excepting the great canines, or tusks, in the male apes, there is also similarity in structure

artery, and the pulmonary artery (to the lungs) from what corresponds to the fourth branchial artery.

(III.) In the third place, we rank vestigial structures in the stricter sense—dwindling residues persistent in adult life, but either functionless or relatively unimportant. A good instance is afforded by the third eyelid—a minute fold which lies in the median angle of the eye. It is larger in some races than in others—these vestigial structures are notably variable—but it is never of use. It is, however, a relic of a functional third eyelid, or "nictitating membrane," seen in most mammals, birds, and reptiles. In these it has a special muscular arrangement which flicks it across the eyeball, and it serves to clean the surface of the eye. It is absent in whales and their allies, and we may connect this with the continual washing of the eye with water. It is vestigial in monkeys and mankind, and we may connect this with the mobility of the upper lid, and also with the better development and greater mobility of the lower lid. It is instructive to compare the rudimentary third eyelid in man with the so-called "epicanthus" which is conspicuous in Mongolians, giving rise to the slit-like appearance. This is a prolongation of the upper lid over the inner angle of the eye, and is apparently due to the flatness of the bridge of the nose which leaves the



THE SO-CALLED TAILS IN MAN AND THE GORILLA

The caudal, or tail, vertebræ of the spinal column in man being rudimentary, the tail is practically absent, but is distinctly evident in the gorilla

superfluous skin to form the fold in question. "According to Ranke, about 6 per cent. of Caucasian children exhibit a markedly Mongolian type of eye during the first six months of their lives."

Darwin gave a number of good examples of vestigial muscles in man, such as those which are occasionally strong enough to move the trumpet, or pinna, of the ear, or the thin sheet below the skin of the neck and some other regions—a residue of the *panniculosus carnosus* which spreads like a mantle over the back, head, neck, and flanks of many mammals, and is of use in twitching off flies and the like. There is a memorable passage in "The Descent of Man": "He who rejects with scorn the belief that the shape of his own canines, and their occasional great development in other men, are due to our early forefathers having been provided with these formidable weapons, will probably reveal by sneering the line of his descent. For though he no longer intends, nor has the power, to use these teeth as weapons, he will unconsciously retract his 'snarling muscles' (thus named by Sir Charles Bell) so as to expose them ready for action, like a dog prepared to fight."

The list of retrogressive muscles is very long, and the degree of their retrogression is diverse and variable. Two of the best illustrations are afforded by the palmar muscle of the fore limb and the plantar muscle of the hind limb, which used to have to do with bending the digits, but have become superfluous by the differentiation of other muscles, and through the specialisation of the foot as a supporting and ambulatory organ. The two muscles in question vary considerably in the degree of their degeneracy. They are sometimes still functional, but they are often completely reduced to tendinous

tissue. As Professor H. F. Osborn says, these two muscles illustrate "organs so far on the down grade that they are mere pensioners of the body, drawing pay—i.e., nutrition—for past honourable services without performing any corresponding work."

As another instance of a dwindling muscle, we may mention the small subclavius which underlies our collar-bone, or clavicle, and steadies the latter during the movement of the arm. It is an insignificant tag of flesh; it is sometimes represented by a non-contractile band of fibrous tissue; it is occasionally absent; it is certainly dwindling.

It is of some importance to distinguish vestiges which have dwindled into insignificance from vestiges which, though in process of reduction, are still very far from a vanishing point, and are often large enough to be mischievous. It is a noteworthy fact that these larger vestigial organs are particularly apt to be seats of disease, as is well known to all in connection with the most familiar instance, the vermiform appendix on the human intestine. Structures which are not essential to the economy of the body, on which selection has lost its grip, are apt to cross the border-line between degenerative change and disease.

To understand the vermiform appendix we have to recall the fact that in many vegetarian animals there is a large cul-de-sac, or cæcum, growing out at the junction of the small and large intestine, which serves to increase the digestive absorptive surface. In the rabbit, for instance, the cæcum is the largest part of the whole intestine, and it bears at its blind end the vermiform appendix. In man and anthropoid apes there is a very short cæcum, and at the end of it there is the vermiform appendix, a dwindling vestige, but still from two to eight inches in length.



A GROUP OF AUSTRALIAN ABORIGINES, THE LOWEST TYPE OF THE HUMAN RACE

MAN, THE SUPREME MAMMAL

It has the same general structure as the intestine, though with a large proportion of adenoid or lymphatic tissue, but everything points to its retrogressive character. It is *relatively* longer in the embryo than in the adult; it is very variable; it is often closed either partially or wholly—apart from artificial blocking or pathological obliteration; it often shows degenerative changes in its tissues. Everyone knows that this remnant that has outlived its usefulness, this anachronism surviving from a remote past, often costs a man his life. It is "like an idle person in a community," peculiarly liable to go wrong and give rise to serious mischief.

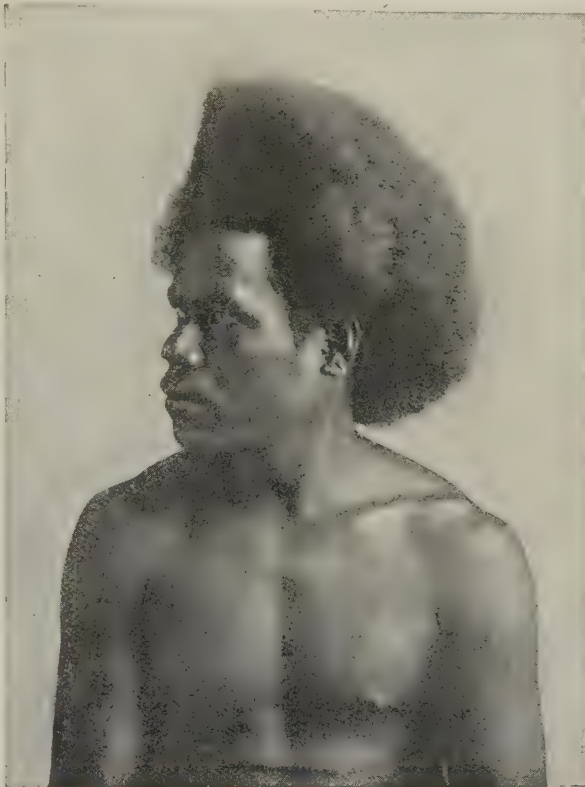
It is important to get away, once for all, from the static conception of a living creature as something fixed and finished, for careful measurement always shows that organs fluctuate continually from generation to generation. Most of them are kept relatively stable by the averaging implied in the conditions of inheritance and by the pruning action of natural selection, but some are on the up grade, others on the down grade, and vestigial structures are among the latter. When we consider the matter in this broad way, we see why it is impossible to give a strict definition of a vestigial organ. For some persist in adult life, and others are purely embryonic; some have a slight secondary use, others an occasional use, and others apparently no use at all. We understand, too, why vestigial organs should be very eminently variable. "This is intelligible," Darwin said, "as they are useless, or nearly useless, and consequently no longer subjected to natural selection. They often become wholly suppressed. When this occurs they are nevertheless liable to occasional reappearance through reversion." What has lain latent for generations may suddenly find re-expression.

There is something very fine in the closing words of "The Descent of Man": "We must, however, acknowledge, as it seems to me, that man, with all his noble qualities, with sympathy which feels for the most debased, with benevolence which extends not only to other men, but to the humblest living creature, with his God-like intellect which has penetrated into the movements and constitution of the solar system—with all these exalted powers—man still bears in his bodily frame the indelible stamp of his lowly origin."

RECONSTRUCTION OF PRIMITIVE MAN

"By considering the embryological structure of man—the homologies which he presents with the lower animals, the rudiments which he retains, and the reversions to which he is liable—we can partly recall in imagination the former condition of our early progenitors. We thus learn that man is

descended from a hairy, tailed quadruped, probably arboreal in its habits, and an inhabitant of the Old World" (Darwin: "Descent of Man," p. 930). It is very difficult to advance from this to an imaginative reconstruction of the appearance of those who first called themselves men, who first began to recognise the year—with its suggestive object-lesson of recurrent sequences—who first became aware that their race had a history. Two general statements may be made, (a) that the stock had diverged considerably from the ancestral stem common to it and to the anthropoid apes, in acquiring a bigger brain, a better forehead, a free hand, an upright gait, and so on; (b) that we must not attach too much importance to the lowest races of men living to-day, like the Bushmen of South Africa, since these peoples appear



A NATIVE OF THE FIJI ISLANDS

to be in some respects actually degenerate.

In regard to many points, we can only guess, which is not science; but one of the safest lines is to study the dwindling structures in man, and work from these backwards to a reconstruction of the primitive type. Thus Professor Wiedersheim writes ("The Structure of Man," Trans., p. 216): "There would appear to have been a time when our ancestors were protected against the inclemencies of the weather by a natural covering of hair, and against insects and other injurious influences by an extensive tegumental musculature; when the pinna of the ear, more advantageously disposed than at present, and moved by numerous and powerful muscles, collected the sounds of approaching danger incomparably better than at the present day, and when the sense of smell, probably intensified by Jacobson's organ, was more highly developed than now." . . . "The intestinal tube may have been longer, and thus better suited than at the present day for vegetable diet, the ancestor of man enjoying at any rate more favourable conditions of existence as a vegetarian than his

successor now does (compare also the former greater number of cheek teeth). He may also have had the further advantage of not possessing a vermiform process of the cæcum which predisposes to disease, and causes the destruction of a considerable percentage of his fellows."

It is probable that Primitive Man was more muscular, especially about the shoulders, neck, and jaws; that he had a stronger development of skin-twitching and ear-moving muscles; that he had a moderate amount of pigment in his skin, and that he was very variable in this respect; that he had a retreating forehead, strong ridges above the eyes, prominent cheekbones, a flat nose, a highly developed sense of smell, and larger, less regular teeth. It is probable that some features were only incipient, such as the chin, the mobile lips, and the woman's breasts.

As to the mental endowment of our early ancestors, we cannot, of course, do more than speculate. But perhaps there is some degree of truth in that extraordinarily vivid picture which Æschylus gave of them—living in caves without fire, without woodwork, without system, without seasons, without foresight; a dream-life without judgment:

And, let me tell you, not as taunting men,
But teaching you the intention of my gifts,
How, first, beholding they beheld in vain,
And hearing, heard not, but, like shapes in dreams,
Mixed all things wildly down the tedious time,
Nor knew to build a house against the sun
With wicketed sides, nor any woodwork knew,
But lived like silly ants, beneath the ground,
In hollow caves unsunned. There came to them
No steadfast sign of winter, nor of spring
Flower-perfumed, nor of summer full of fruit,
But blindly and lawlessly they did all things,
Until I taught them how the stars do rise
And set in mystery, and devised for them
Number, the inducer of philosophies,
The synthesis of letters, and, besides,
The artificer of all things, Memory,
That sweet muse-mother.

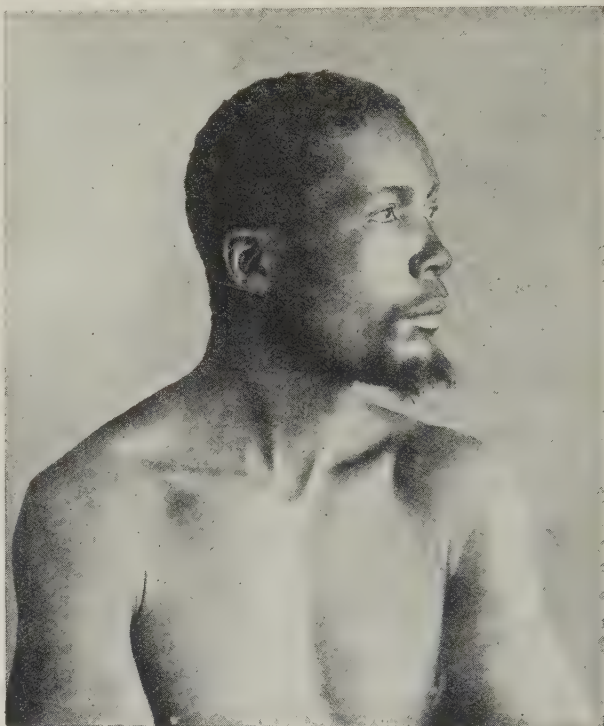
Compared with his ancient ancestors, man has probably lost much in the way of brute strength, but he has profitably bartered this for a more alert and educable brain, a greater manual dexterity, an increased power of articulate speech, and a growing gentleness. We can well imagine that what seems to have been true at other great epochs in the history of animate Nature was true of the ascent of man—that the loss of certain advantages was at once a condition and a consequence of gaining others.

THE ORIGIN OF MAN

We cannot at present get beyond the general conclusion that man sprang from a stock common to him and to the higher apes. It is quite certain that he is not a scion of any existing simian stock, though his lineage has been collateral with theirs. Evidence is accumulating to show that discontinuous variations, large in amount and qualitatively novel, sometimes occur in Nature, and it may be that man arose as a *mutation* of this sort, as an anthropoid genius, taking a big step all

at once. Not, indeed, that he can be thought of as rising suddenly to the height of his dignity, but rather that some important cerebral variation occurred brusquely and led on to consequences which were very gradually disclosed as in any childhood to-day. The origin of man, whether by the slow accumulation of minute cerebral variations or by a brusque mutation, was a step so wonderful that it is on a *priori* grounds difficult to believe that it was taken more than once. There are, however, accomplished anthropologists who firmly believe that the human race made more than one start.

As to the factors which led to the emergence of the human type in an ancestral simian stock, we



A ZULU, OR KAFFIR, OF CAPE COLONY
Photograph by G. W. Wilson & Co.

can only speculate. We must remember that the order of Primates is marked by great intelligence; that we find amongst them habits of walking semierect, of using sticks and stones, of building shelters, of living in families, of co-operating in bands, and of talking a great deal.

It is noteworthy, also, that we find among apes the prolonged ante-natal life which is characteristic of very intelligent mammals, and may have had something directly to do with the improvement of wits, just as the prolonged human infancy has had to do with the growth of gentleness. Darwin fully recognised that the survival of the human pioneers must have been due, not merely to their cleverness, but to their social instincts.

It is often said that an alleviation of the struggle for existence must have been a condition of the ascent of man, but, while we do not in the strict sense know anything about it, we may perhaps state

the case more accurately in the proposition that the ascent of man was associated with a form of struggle in which brains meant more than muscle, and co-operation more than competition.

Although the anthropoid apes are not social creatures, there are many social monkeys. Families combine for protection, and the sociality promotes emotional and intellectual strength. When we realise how largely the human mind is still a social product, we see the force of the epigram: "Man did not make society; society made man."

THE ANTIQUITY OF MAN

A false standard of time and a misunderstanding of the Holy Scriptures led pre-Darwinian naturalists to ignore the immense antiquity of the human race. It is true that in 1836 the French antiquary, Boucher de Perthes, discovered flint axes lying along with the bones of extinct mammals in undisturbed gravel-beds from twenty to thirty feet below the surface, but he had to wait almost twenty years for a fair hearing—even Darwin looked askance—and yet longer for decisive corroboration. Both were gained, however, when Sir Charles Lyell summarised the existing evidence in 1863 in his "Antiquity of Man."

It is certain that men lived in Europe at a time when mammoth and rhinoceros, hyæna and lion, were still abundant there, and that he used stone weapons against them. From the situations in which these palæolithic implements have been found, it is inferred, more or less precariously, that these must have dropped from their makers' hands at least 150,000 years ago. But these stone implements are not the work of novices, they are well-finished articles compared with the earlier eoliths, which probably take us back for another 150,000 years, or farther. It must be noted, however, that these eoliths are often very debatable, for it is difficult to be certain that their marks are those of workmanship and use.

No fossil remains of man have been found except in Post Tertiary (Diluvial) deposits, but there are some vague indications of his presence in the preceding Pliocene Age. An indirect argument leads us to put the origin of the human stock even earlier; for as it is certain that man could not have arisen from any of the known anthropoid apes, but from a stock common to them and to him, it seems likely that the human stock had diverged before the time when the anthropoid apes are known to have been established as a distinct family. This takes us back to Miocene ages, for there are remains of extinct genera of gorilla and chimpanzee in Miocene strata, and that means hundreds of thousands of years ago.

Whether man had emerged as man in Tertiary times or not, his antiquity is to be measured not in centuries, but in millennia, and his migrations had begun while land bridges existed that are now broken, for instance, while Asia was still linked to North America.

THE PREHISTORIC RECORD

The study of prehistoric man is quite young, practically beginning about the middle of the

nineteenth century in the study of caves and lake-dwellings, "kitchen-middens," stone implements, and actual human remains, but it has already been rewarded by discoveries of the highest interest. It is generally recognised that man had made considerable progress by the time of the later Glacial periods, and that he was a contemporary in Europe of the mammoth and its predecessor *Elephas antiquus*, of the cave lion, and the cave bear, and other extinct mammals. There was a long-drawn-out Stone Age antecedent to the use of metals, and it is divided into a Palæolithic period, when the weapons and instruments were rough and unpolished, and a Neolithic period, when they were polished, neatly finished, and often bored. Here and there—in England, in the valley of the Meuse, in the Neanderthal, at Heidelberg, in North America—remains of early man have been unearthed, which disclose interesting primitive features. "The salient features of these ancient men," writes Professor G. B. Howes in his preface to the translation of Wiedersheim's book already named, "are a low, retreating and contracted forehead, and an inwardly shelving occiput—indicative of a primitive type of brain and of powerful neck muscles; a high temporal ridge, and an expanded palate—indicative of powerful jaws and jaw muscles; and, further, the presence of ape-like brow ridges—for which the famous Neanderthal calvaria is so notorious—appears also to have been a racial character."

The older Diluvium deposits in the Neanderthal, near Düsseldorf, yielded in 1856 the roof of a skull and some limb bones, and authorities such as Professor Schwalbe regard the skull as belonging to a form different from any of the races of man now living, and as type of a more primitive species, which Schwalbe named *Homo primigenius*.

In 1886 Fraipont described two skulls and skeletons from Spy, in Belgium, found along with remains of the cave bear, mammoth, and rhinoceros; in 1899 and subsequent years Gorjanovic-Kramberger obtained parts of about ten individuals in a cave near Krapina, in Croatia, along with bones of cave bear and rhinoceros; an important skull from Gibraltar has been carefully studied by Schwalbe and Sollas; various remains have been found at Mentone, at Heidelberg, and elsewhere. The net result, according to many anthropologists, is to suggest a still somewhat dimly described species, *Homo primigenius*, occupying an intermediate position between the highest apes and the lowest living human races. It is mainly as regards the skull that this "Neanderthal race" differs from the *Homo sapiens* of historic times; the forehead was low and retreating, the supraorbital ridges were strong, the cranial capacity was distinctly less, the teeth were stronger, and the chin was only hinted at.

It is the opinion of many anthropologists that the species *Homo primigenius* was not gradually transformed into *Homo sapiens*, but was supplanted by the latter, a scion of the same stock, possibly originating in Southern Asia.

"PITHECANTHROPUS"

In 1891 Dr. Eugène Dubois discovered in alluvial volcanic tufa on the banks of the Bengawan river, near Trinil, in Java, some very interesting, genuinely fossilised remains, a skull-cap, a thighbone, and two back teeth—which he regarded as belonging to a type intermediate between man and anthropoid apes. The water-borne deposit in which they were found probably dates from the Older Diluvium, but some would say Pliocene. Dubois called his discovery *Pithecanthropus erectus*, and, although there was not very much to come and go on, it may be noted that species, which subsequent discoveries have proved to be very distinctive, have often been based on a vertebra, a tooth, or even a scale. But there is not as yet unanimity in regard to *Pithecanthropus*. Some critical investigators, such as Pettit, Cunningham, and Turner, maintain that the remains are strictly human, while others, such as Schwalbe, regard them as transitional—a link no longer missing—between apes and man. On the one side, it is confidently stated that the skull-cap is human, but indicative of a type rather more primitive than the man of Neanderthal; on the other side, it is confidently stated that *Pithecanthropus*, though intermediate between apes and man, is more closely allied to the apes. Some regard this rather shadowy form as one of the direct ancestors of man, and others as a side-track failure.

An experienced zoologist, Mr. F. E. Beddard, in his volume on the "Mammalia" in the "Cambridge Natural History," reconstructs *Pithecanthropus erectus* in the following terms. "The animal when erect must have stood 5 ft. 6 in. high. The contents of the cranium must have been 1,000 cm.—that is to say, 400 cm. more than the cranial capacity of any anthropoid ape, and quite as great or even a trifle greater than the cranial capacity of some female Australians and Veddahs.

"But as these latter are not 5 ft. in height, the ape-like man had really a less capacious cerebral cavity. The skull in its profile outline stands roughly midway between that of a young chimpanzee—young in order to do away with the secondary modifications caused by the crest—and the lowest human skull, that of Neanderthal man. This creature is truly, as Professor Haeckel put it, 'the long-searched-for missing link'—in other words, represents 'the commencement of humanity.'"

As the greatest experts differ markedly in the interpretation of the sparse remains of *Pithecanthropus*, a suspension of judgment seems the most scientific frame of mind, but the divergence of opinion is interesting in showing the close relationship of the simian and the human.

RACES OF MANKIND

No secure conclusion has been reached as to the most natural classification of the numerous human races. So far as is known, they are all mutually fertile, and there are often intergrades between strongly contrasted types. Some characters seem to blend readily, while others, more firmly

established, tend to persist without blending when grafted on to another race. Crosses between remotely related races do not usually prove a success, yielding unstable or even reversionary half-breeds. It must be remembered that in the breeding of animals steady advance has always rewarded mating within a narrow range of relationship.

The following scheme of classification is very widely accepted as at least convenient.

I. NEGROID RACES. Usually with frizzly hair, dark skin, broad nose, thick lips, prominent eyes, large teeth, narrow pelvis, and dolichocephalic or long-headed skulls—e.g., Sudanese Negroes, such as Hausas; Bantus, such as Zulus, Bechuanas; Hottentots; Bushmen (practically extinct).

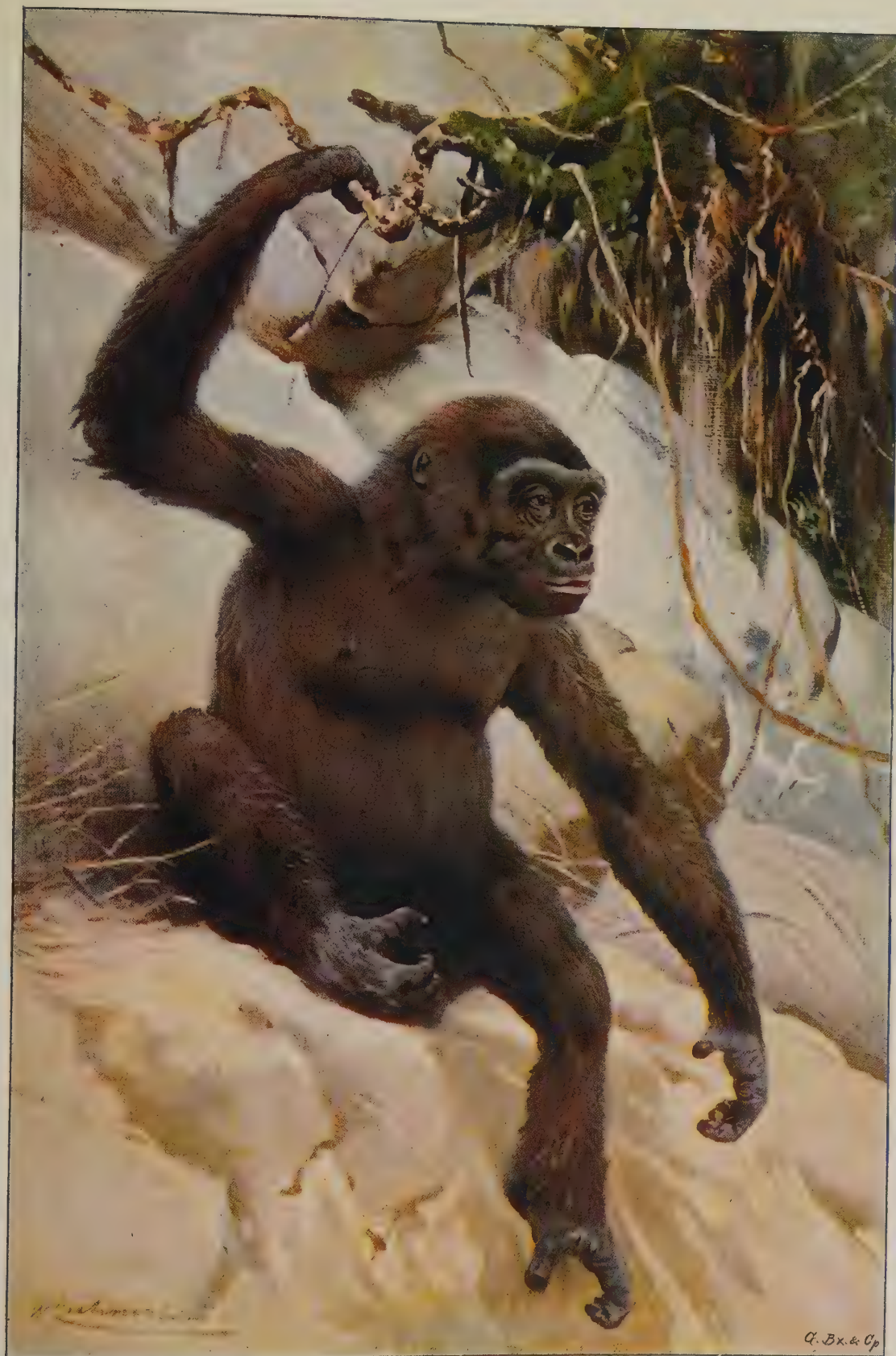
II. MONGOLIAN RACES. Usually with black, straight hair, yellowish skin, broad face, prominent cheekbones, small nose, sunken narrow eyes, teeth of moderate size, and a variable skull—e.g., Chinese, Japanese, Burmese, Tibetans, Lapps, Finns, Eskimos, Malays.

III. CAUCASIAN RACES. Usually with soft straight hair, well-developed beard, variable skull, retreating cheekbones, narrow and prominent nose, small teeth, and broad pelvis—e.g., Europeans; Hamites, such as Berbers; Semites, such as Jews and Arabs; Hindus.

STRUCTURAL PROGRESS IN MAN. While some parts of the human frame are dwindling, there are others which the anatomists declare to be on the up grade. In other words, there is evidence of progress in fitness. Professor Wiedersheim gives the following illustrations among others: higher differentiation and more subtle development of the muscles of the thumb; increase in the physiological efficiency of the hand in general; strengthening of the arch of the foot, the ankle, and the great toe; perfecting of the whole lower limb for support and locomotion; widening of the hip girdle in women; more subtle differentiation of the facial muscles as distinguished from those of the scalp and of the ear; more subtle differentiation of the muscles of the larynx; higher development of the brain, especially of the cerebral hemispheres. It should be noted that the careful collection of data in regard to variations in man is of the greatest significance, for in this way alone can a basis be found for judgment as to whether a structure is progressive, retrogressive, or practically stationary. It is also necessary to distinguish from these inborn variations, which arise from within, all the acquired modifications, which are superimposed from without. For, while the former are transmissible in inheritance, we cannot at present say that this is ever true of the latter.

While there is definite evidence of progressive variation in man, there is nothing to lead us to believe that any marked change will be wrought out in man's highly finished bodily frame. Everything appears to point, rather, to the conclusion that the line of human evolution will be that of increasing utilisation and command of the brain, with which there will be doubtless correlated an improvement in the social framework which forms man's external heritage.

J. ARTHUR THOMSON



THE GORILLA

"Although somewhat unwieldy creatures, they are active and indefatigable climbers, and are said to ascend to the very tops of the forest trees."



THE ORANG-UTAN

This "Man of the Woods" is supposed to need its shaggy coat of reddish brown hair to protect it from the tropical rains of its native forests and the attacks of mosquitoes and other pests.



THE WHITE-HANDED GIBBON

Like the other long-armed apes, this gibbon can actually walk upright on its hind legs. When alarmed, it holds its arms high in the air, its face turns white and it utters a loud and unearthly cry.



THE GREEN MONKEY

"Although gay and gentle during youth, this monkey becomes morose and vicious when old.

THE EVOLUTION OF THE LEMURS, MONKEYS, AND APES

A DISCUSSION OF THEIR ORIGIN AND DESCENT

By R. I. POCKOCK

THE positive characters absolutely distinctive of the Primates as a whole are comparatively few, yet every existing member of that order may be distinguished from every other mammal by a complex of structural features; so that if in one or more characters a species fails to conform to the plan typical of the rest, appeal may be made to others to establish its right to be classified as a primate. The dentition, for instance, of the aye-aye (*Daubentonia*) deviates widely from that of other genera of the order in its analogy to the dentition of rodents; nevertheless, the structure of the hands and feet and of other organs shows clearly that the animal is an aberrant lemur. Similarly, the great toe of marmosets and men is not opposable to the other toes, yet the sum total of the characters of these animals attests unmistakable kinship with monkeys.

When the characters of existing primates are passed in comparative review, the order seems to be derivable from a generalised type, the hypothetical ancestral form, presenting the following features, mainly structural. A skull with prominent jaws armed with teeth of a tolerably primitive pattern, but reduced in numbers to $i.\frac{2}{3}$, $c.\frac{1}{1}$, $p.m.\frac{3}{3}$, $m.\frac{3}{3}$, the inner incisors of the upper jaw being large and in contact; an orbit encircled by a bony ring, but communicating freely with the temporal fossa; a comparatively small cranial portion containing a brain, with the cerebellum not overlapped behind by the cerebrum; a long non-prehensile tail; a pair of collar bones; limbs plantigrade, nearly equally developed, freely movable from the hip and shoulder girdles, the two long bones (radius and ulna, tibia and fibula) separated from each other, the feet five-toed, the first toe (hallux) of the hind foot being flat-nailed, large, and freely opposable, while the corresponding toe (pollex) of the front foot, although relatively smaller, was also opposable, but to a lesser degree; an alimentary canal with a simple stomach and a large cæcum, and other features concerned with the internal anatomy.

In these conclusions is found complete justification for the statement that the primates, as a whole, are a group of lowly organisation and humble origin. Except, indeed, for the reduction in the number of the teeth, the annular orbit, and the opposable first digits, they do not differ greatly from the hypothetical primitive eutherian mammal; and when some fossil forms, closely related apparently to the lemurs, are discussed, it will be found that one form (*Hyopsodus*) has been discovered with the complete dentition and incomplete orbits regarded as present in the generalised type. We may even go still

further, and say that the presence of collar bones, of five toes on each foot, and the distinction of the radius from the ulna, and of the tibia from the fibula are features the primates have inherited unchanged from some very early five-toed type which preceded the reptiles in vertebrate evolution; and it is highly probable that the freedom of the limbs from the shoulders and the hip must also be assigned to this same remote and lowly origin. One has only to note the undeniable likeness between the limbs of human beings and of frogs or salamanders to find ample support for this supposition.

Coming now to a consideration of the subdivisions of the order, the Prosimiæ, which constitute the first suborder, are shown by a complex of characters not necessarily found in any one individual to be less highly organised than the anthropoidea—that is to say, they have departed, as a group, less widely from the generalised eutherian type from which the hypothetical ancestral primate was not far removed. In the skull the jaws, as a rule, are larger and the braincase smaller, and the brain itself less highly developed than in the anthropoidea; and only in one case is there a bony partition separating the orbit from the temporal fossa. The dentition is more varied than in the anthropoidea; but one family, the Lemuridæ, retains typically the primitive number of teeth believed to have been possessed by the immediate ancestor of existing primates. Moreover, by means of certain fossil forms the existing Prosimiæ are connected with other extinct species presenting a still earlier and more generalised type of skull and teeth.

These extinct lemur-like primates, represented principally by skulls or pieces of skulls and teeth, have been discovered in Eocene beds of Europe, North America, and South America. Their classification is a matter of very great difficulty, and this is in no sense overcome or concealed by referring them to a distinct order or suborder, the Mesodonta or Pseudolemuroidæ, as has been done by some naturalists.

One of the most interesting of these early types is the North American genus *Hyopsodus*, which was about the size of a lemur, with a somewhat dog-shaped skull, the jaws being strong and prominent, and the cranium depressed. The word *hyopsodus* means "with pig-like teeth," and the name alludes to the fact that the animal had forty-four teeth, like a pig, the dental formula being: $i.\frac{3}{3}$, $c.\frac{1}{1}$, $p.m.\frac{4}{3}$, $m.\frac{3}{3}$, that is, the same as in primitive members of other orders of eutherian mammals. In this respect *Hyopsodus* differed from all other primates.

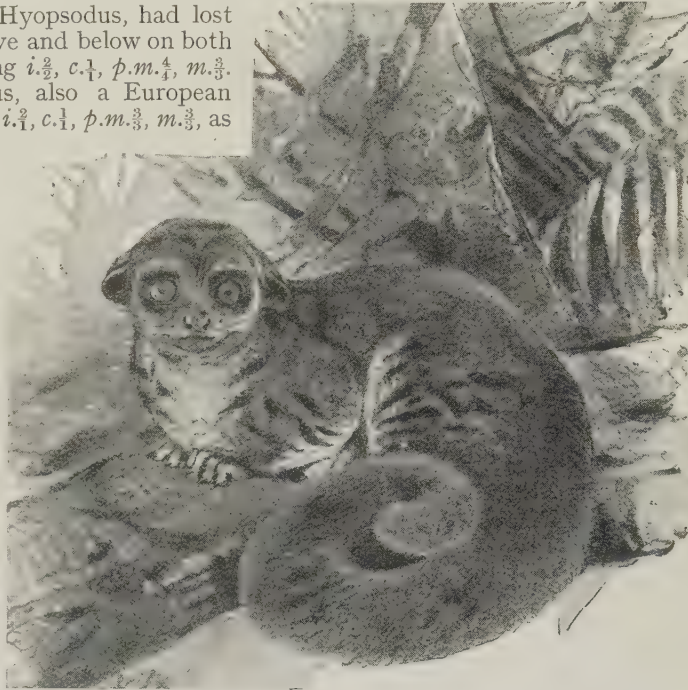
Another of its primitive and peculiar features was the absence of the bony bar surrounding the orbit behind, which is found in all other primates, whether living or extinct, but is commonly absent in other orders of mammals.

It is interesting to trace in these extinct lemuroids a gradual lessening in the number of the teeth, until the number found in existing lemurs and American monkeys is reached. The European *Adapis* and the South American *Notopithecus*, for example, while retaining the same number of cheek teeth and canines as *Hyopsodus*, had lost one of the incisors above and below on both sides, the formula being $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{4}{4}, m.\frac{3}{3}$. Again, in *Microchoerus*, also a European genus, the formula was $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{3}{3}$, as in the *Cebidæ*, except that an additional lower incisor on each side was lost; while the number of teeth in *Plesiadapis* was nearly the same as in the indrisine lemurs, except for the suppression of one more lower incisor; the formula is $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{2}{2}, m.\frac{3}{3}$. It is not to be inferred, however, that the genera just mentioned differed only in the numbers of their teeth; nor that those that approached existing primates in these particulars were like them in other respects. They exhibited great

differences in the number, size, and shape of the tubercles of their grinding teeth, in the shape of their skulls, the size of their jaws, and in other cranial features. So great, indeed, are the differences that each one of the genera mentioned has been made the type of a special family; but not one of these families appears to be closely related to or exactly in the line of descent of any of the existing primates. Such forms as *Hyopsodus* and *Adapis*, however, do supply evidence of the descent of the primates from some more generalised mammalian stock akin to the insectivora.

The first tribe of Prosimiæ, the lemuroidæ—which includes the lemurs, galagos, lorises, pottos, and sifakas—contains far the greater number of existing and extinct species of the group. The variations in structure and habits they present are almost as great as those exhibited by the anthropoidæ. The lowest position in the tribe must be given to the Lemuridæ, or true lemurs, most of which retain the dental formula $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{3}{3}$; but, apart from this, the teeth are not all of a primitive type, the front teeth in both jaws being modified in a way that attests considerable departure from the ancestral

type. For example, the canines and incisors of the lower jaw are greatly reduced in size, and project so as to form a small comb-like structure, the function and appearance of the lower canine being assumed by the first premolar. The canine of the upper jaw is normal and sharp, but the incisors are very small, and show a tendency to partial or total suppression in the adult. In the African galagos and in the Madagascar lemurs, of the genus *Lemur*, the four incisors are retained with a distinct gap between



COQUEREL'S MOUSE LEMUR

the inner pair; but in the hattock (*Mixocebus*) one pair is lost; and in the sportive lemur (*Lepilemur*) both pairs are absent. The sportive lemurs, unlike the true lemurs, are nocturnal, and have large orbits and naked membranous ears. They also have the ankle joint somewhat elongated. In these particulars they approach the so-called mouse lemurs (*Chirogaleus*, *Microcebus*) of Madagascar, and the galagos of Africa, in which the ankles are still more elongated. This structural peculiarity reaches an extreme in some members of the Galago genus, where it is clearly connected with the astounding

leaping powers of these arboreal animals. Another structural peculiarity connected with their activity is the extraordinary gripping power of the hands and feet, the fingers of which are furnished with expanded terminal adhesive discs so that when springing from bough to bough they clutch with a strength which makes a fall impossible. In these respects the galagos are more highly organised than the true lemurs, though in others connected with the ear bones of the skull they are more primitive.

All the lemurs hitherto mentioned have long tails and are active leapers, with the hind legs longer and stronger than the front legs. Contrasted with them in the matter of habits are the slow lemurs (page 163), which may be described as specialised crawlers, just as the galagos are specialised jumpers. The arms of the slow lemurs are relatively longer, and they appear to be quite unable to leap. They have, however, the same tenacity of clutch as the galagos, and, to give the hands a wider span, the digit corresponding to the forefinger of the human hand is greatly reduced in size or quite vestigial. The tail also is shortened or reduced to a small knob. They furnish, indeed, an admirable illustration of the law

THE EVOLUTION OF THE LEMURS, MONKEYS, AND APES

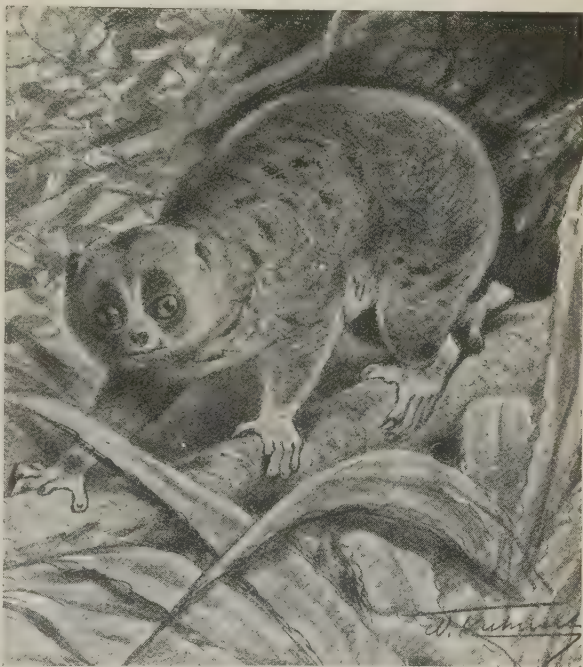
that the tail undergoes degeneration in arboreal mammals that lose activity, and especially jumping power. The slow lemurs are found in Tropical Southern and Eastern Asia (*Loris* and *Nycticebus*), and in Tropical West Africa (*Perodicticus* and *Arctocebus*); and it is probable that they were evolved from some early lemuroid form, which was also the ancestor of the galagos, in a continental area embracing Africa and Southern Asia, but not including Madagascar.

Although agreeing with the Lemuridæ in most points, the group of existing lemurs called the Indrisidæ, and containing the endrinæ and avahis, differs from them essentially in dentition, the formula being $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{3}{3}$. They have thus lost the lower canine tooth and one premolar tooth above and below on each side. The lower incisors are procumbent, as in the typical lemurs; but the median upper incisors are sometimes, as in the sifakas (*Propithecus*), of comparatively large size and closer together, approaching in these particulars the condition of the ancestral form. The brain also is better developed than in the Lemuridæ. In habits the endrinæ are less quadrupedal than are the true lemurs, and are said to walk upright among the branches of trees, and to progress on the ground by leaping, holding the arms above their heads. It will thus be seen that both in structure and habits the Indrisidæ are, on the whole, a more highly specialised group than the Lemuridæ. Nevertheless, they are not derivable from any known member of the latter family.

Researches in Madagascar, however, have brought to light the remains of many remarkable lemurs, some of which prove that this group formerly attained a size and bestiality of appearance unsuggested by existing species; while others reveal affinities not only with the Lemuridæ and Indrisidæ, but also with the South American monkeys, or Cebidæ. The most interesting forms belonging to the first category are Megaladapis, related to the Lemuridæ; and Palæopropithecus, akin to the Indrisidæ. Judging from the structure and dimensions of the skull, which sometimes exceeds twelve inches in length, and is low, flattened, and narrow, with long, projecting, powerful jaws and small, oblique orbits, Megaladapis was an animal of small intelligence but of great size and strength. The teeth, broadly speaking, are like those of the Lemuridæ, except that the elongation of the jaw leaves a long, toothless space between the long cutting canine of the upper jaw and the caniniform premolar of the lower jaw and the upper and lower cheek teeth respectively. This gigantic lemur was nearly equalled in size by the huge indrisoid genus Palæopropithecus, the skull of which measured about seven or eight inches in length. The braincase was relatively larger and the jaws were shorter than in Megaladapis. The jaws, nevertheless, were considerably produced, very massive, and somewhat upturned at the extremity. The small orbits, too, looked forwards and upwards. The conformation of the skull, indeed, recalling somewhat that of a hippopotamus in the elevation of the orbits and nose, suggested to Dr. Standing the possibility of

this lemur being aquatic, and adapted for lying under water with only the eyes and nostrils projecting above the surface. It is not unlikely, however, that the upwardly inclined nose and orbits, associated with a massive lower jaw in Palæopropithecus, were accompanied by a greatly inflated hyoid bone giving resonance to the voice, as in the case of the howler monkey (*Alouatta*) of South America, to the skull of which that of the great extinct lemur in question shows many curious resemblances in profile view.

These two highly specialised lemurs throw no light upon the descent of existing forms of the Prosimiæ or of the Anthropoidea. Much more interesting from this point of view is the smaller extinct form Archæolemur, which should, perhaps, be made the type of a distinct family, intermediate in certain respects between the Lemuridæ and Indrisidæ, and



THE SLOW LORIS

approaching nearer than either to the American monkeys, or Cebidæ. The dental formula was $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{3}{3}$. Thus in the numbers of the premolars Archæolemur resembled the Lemuridæ and the Cebidæ, but differed from them, and approached the Indrisidæ in the loss of the lower canine. Especially monkey-like were the incisor teeth, of large size, the inner pair of the upper jaw being exceptionally large and contiguous, while those of the lower jaw were hardly at all procumbent. The jaws were comparatively short, and the profile of the face ran obliquely upwards to the postorbital frontal region, and the orbits were small and directed forwards. The braincase, however, was low and receding, and was deeply constricted behind the orbits, as in other extinct lemurs, and there was no postorbital bony plate such as all anthropoids possess.

It was probably from some lemurs akin to Archæolemur that the existing Lemuridæ and Indrisidæ have been evolved, and possibly some extinct form combining some of the characters of Archæolemur and of Tarsius was the ancestral type of the anthropoidea. In any case, Archæolemur and Tarsius—to be described presently—are the two genera of the Prosimiæ which in their characters overlap the Prosimiæ, on the one hand, and the Anthropoidea, on the other.

The second tribe of prosimian primates, the Chiromyoidea, contains the Mascarene nocturnal lemur known from its cry as the Aye-aye. This genus differs widely in dentition from all other primates, the formula of the adult being $i.1, c.0, p.m.1, m.3$. Not only has there been suppression in the number of incisors, canines, and premolars, but the incisor teeth that remain are enlarged, laterally compressed, in contact, with enamel only on their front surfaces, and grow from persistent pulps like those of a rodent. The aye-aye is sufficiently peculiar in other ways, such as the high, compressed muzzle, the cleft upper lip, and claw-like nails, to be placed in a separate family (Daubentoniiidæ) from the true lemurs. The immediate ancestor of the aye-aye is unknown, but its structure supplies evidence that it traces its descent from some extinct form of the Indrisidæ. The formula of the milk teeth, for example, is $i.2, c.0, p.m.2, m.3$, which, making allowance for the absence of the molars, is the same as that of existing Indrisidæ, except that one additional premolar has been suppressed. Moreover, as has also been remarked, the large size and juxtaposition of the incisors of the permanent set suggest that the ancestor of this animal branched off from some form of Indrisidæ in which the inner incisors, both above and below, were also large and in contact. Nevertheless, this lemur cannot logically be placed in the last-mentioned family.

The third prosimian tribe, the Tarsioidea, contains the single genus, known as the Spectral Tarsier (*Tarsius*), which, with a close superficial resemblance to some galagos, combines structural characters some of which are peculiar to itself, while others affiliate it with the galagos, and yet others with the anthropoid primates. The teeth are of a more primitive type than in any existing lemur,

the dental formula being $i.2, c.1, p.m.3, m.3$, and coinciding closely with that of the Lemuridæ, except for the suppression of one lower incisor on each side. The remaining incisor, however, is not so procumbent as in that family, and the canine is more vertical, and the upper inner incisors are moderately large and in contact, as in some Indrisidæ. A marked anthropoid feature is the closing of the orbit behind by a bony wall, the possession of which and of the metadiscoidal and deciduate placenta—which is a later type than the diffuse and non-deciduate

placenta of other Prosimiæ, and shows that the tarsier has reached a higher grade of development than the latter have—suggests that tarsier is descended from some extinct lemuroid stock, also with those attributes, whence the Anthropoidea are also descended. And the dentition of tarsier confirms the evidence from other sources that this stock had a dental formula of $i.2, c.1, p.m.3, m.3$, with canines and incisors subvertical and the inner incisors of the upper jaw larger than the outer and in contact in the middle line. For teeth of this character amongst the Prosimiæ we may look to a form that preceded Archæolemur, and differed from that genus in retaining the lower canine teeth.

The second suborder of the primates—variously called Anthropoidea (man-like) and Pithecoidea (monkey-like)—stands at a higher grade of development than the Prosimiæ. The brain is of a more advanced type, on the whole, as is especially attested by the backward extension of the cerebral hemispheres over the cerebellum, though the howlers amongst the South American monkeys, and the siamang, one of the gibbons, are scarcely, if at all, more advanced in this respect than lemurs of the family Indrisidæ.

SPECTRAL TARSIER

The anthropoid primates are divisible into two tribes: the Platyrrhini, containing the South American monkeys and marmosets, which are confined to Central and South America, and are unrepresented by fossil forms outside that continent; and the Catarrhini, including the monkeys and apes of Europe, Asia and Africa, and man, a group which appears to have been evolved in the Old World, and, with the exception of man, is restricted thereto, both as living and fossil forms.

The Platyrrhini, or American monkeys and marmosets, are more akin to the Prosimiæ than are the Catarrhini. They differ from the latter, and resemble the Tarsiidæ and the true lemurs of the



THE EVOLUTION OF THE LEMURS, MONKEYS, AND APES

family Lemuridæ in retaining three premolar teeth above and below on each side, and in having no definite bony tube developed in connection with the external orifice of the ear in the skull. They further differ from the Catarrhini in having a broad cartilaginous partition between the nostrils, so that in the living animals these orifices are widely and not narrowly separated. The country of their origin is unknown. Fossil species, referable to the two existing families (Cebidæ and Callitrichidæ) occur in recent (Pleistocene) deposits in Brazil; and others (Homunculus), akin to the Cebidæ, in Eocene beds in Patagonia. Unfortunately, these Eocene forms throw no more light upon the descent of the Cebidæ than is supplied by existing species. As has been explained, however, there formerly existed in Madagascar a lemur (Archæolemur) which had many monkey-like characters, showing special resemblance to the Cebidæ; and on the strength of this resemblance it has been suggested that the Platyrrhine monkeys are of African origin—descended, that is, from a lemuroid type evolved in Africa before the subsidence of the Transatlantic bridge which once existed between Africa and South America. Along this bridge, it is supposed by Standing, the ancestors of existing Platyrrhini may have entered South America.

Judging by their teeth, represented by the formula $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{3}{3}$, as well as by other characters, the Cebidæ—of which the best-known examples are the squirrel monkeys, howlers, spider monkeys, and capuchins—stand nearer the lemurs than do the marmosets and tamarins. As compared with the monkeys of the Old World, as well as with the lemurs, the Cebidæ are feeble and inactive. Although essentially arboreal, their leaping powers are poorly developed, and specialisation within the family has taken the line of proficiency in slow, safe climbing among the high branches of the trees they frequent. The squirrel monkeys (*Saimiris*) are, perhaps, the most agile of all, and these resemble the typical lemurs in having a well-developed non-prehensile tail, a character in which they and genera akin to them, like the night apes (*Nyctipithecus*), are more primitive than the rest. Like some extinct lemurs, too, they have vertical lower incisors. Cebidæ with these characters are referred to a sub-family, Nyctipithecinae, to contrast them with the Pitheciinae, the uakaris (*Uakaria*) and the sakis (*Pithecia*), which have procumbent lower incisors recalling somewhat those of existing members of the lemuroidæ. This likeness, however, may be merely adaptive. Both these genera have non-prehensile tails; but while this organ retains its primitive length in the sakis, it is greatly reduced in the uakaris, which, in this respect, depart from the normal type. In the howlers, the capuchins, and the spider monkeys, on the contrary, the tail is retained in a fully developed condition, and has become modified to form a grasping organ of great utility in climbing, exhibiting a deviation from its primitive use as an aid to leaping not found elsewhere in the primates.

The howlers (*Alouatta*) show retrogressive metamorphosis in the structure of their skulls

and brains, their intelligence is low, and their disposition inert as compared with the larger-brained South American monkeys. On the other hand, their vocal organs are highly specialised. Nevertheless, in this particular, as well as in others, they show indications of affinity with some of the non-prehensile-tailed American monkeys, of which they are probably an offshoot, degenerate in some respects, elaborated in others. The capuchins (*Cebus*) more nearly resemble the monkeys of the Old World in the structure of their brain and in intelligence than do any other members of the



THE RED, OR GOLDEN, HOWLER

Platyrrhini. Their limbs are also comparatively short, the hind pair being longer than the front, as in most of the Old World monkeys. The tail, too, although truly prehensile, is normally hairy at the end, whereas in the woolly monkeys (*Lagothrix*) and the spider monkeys (*Ateles*, *Brachyteles*) the tail is naked beneath at the end, and is so sensitive and perfected an organ of prehension that it can be used for picking up objects. In general proportions, and in possessing a well-developed, though not highly opposable thumb, the woolly monkeys have

not departed from the more primitive capuchin type; but in the spider monkeys, the most adept climbers amongst the Platyrrhini, the limbs are very long, the arms exceeding the legs in length, while the great elongation of the hand as a climbing hook has rendered the thumb useless for grasping purposes, so that it has almost or quite disappeared. So far as specialisation is concerned, the spider monkeys must be regarded as the highest type of the Cebidæ.

It seems that the marmosets (page 167) and tamarins, constituting the family Callitrichidæ, may be regarded as a specialised offshoot of some extinct group of the Cebidæ stock. They differ from them in the loss of one molar tooth above and below on each side, the dental formula being $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{2}{2}$. Their other differences appear to be adaptive to a special mode of life. Unlike the Cebidæ, they are extraordinarily active, and possess great leaping powers. Their limbs are short, and their tails long and hairy. In these particulars, as well as in size, they are not unlike squirrels, which they also recall in the structure of their hands and feet, these extremities being more paw-like than in any other primate, the nails resembling claws, and neither the thumb nor the great toe being opposable. Now, the smallness of the hands and feet in these pigmy, probably dwarfed, monkeys makes them incapable of grasping branches of any size, and renders an opposable thumb and great toe of little use for maintaining a secure clutch. Sharp claws, on the contrary, as in the case of squirrels, are excellently adapted for climbing over the rough bark of trees.

In these facts probably is to be found the explanation of the conversion of "nails" into "claws," and of the loss of opposability of the first digit of both front and hind leg in the marmosets. The one method of securing a firm hold has been changed for another in these small arboreal primates. The mouse lemurs, galagos and tarsiers, too, with the same arboreal habits as marmosets, have at the end of their digits specially well-developed discs, with which they tightly grip a branch when alighting on it, a circumstance which suggests that an opposable finger and toe are in themselves insufficient to prevent a fall in leaping animals with hands and feet too small to span stout branches. Now, many Cebidæ have such strongly compressed nails that very little modification would be required to turn them into "claws." The thumb, too, is only slightly opposable, and the change required to convert it into the unopposable first digit seen in marmosets would be insignificant. Hardly more elaborate would be the structural change needed to transform the large opposable great toe of the Cebidæ into the degenerate unopposable great toe of the marmosets, which still, however, retains its primitive lateral direction and its flat nail.

The Catarrhini, or monkeys and apes of the Old World, and man, differ from the Platyrrhini in many characters, the principal being the loss of one premolar above and below on both sides, giving the dental formula $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{2}{2}, m.\frac{3}{3}$, and the presence

in the skull of a bony tube to the orifice of the ear. Of the two tribes into which the Catarrhini are divided, the Cynomorpha stand nearest to the Cebidæ. They typically possess a well-developed tail. The cæcal dilatation of the intestine is not reduced in size at its free end to form an "appendix," and the sternum is laterally compressed.

In these characters they resemble the Cebidæ, and differ from apes and man. But they further differ from the Platyrrhine type in certain characters, one of which, the presence of ischial callosities, or hairless sitting-pads on the rump, is found in both the families, serving to link them together; while of the remaining characters, one, the presence of pouches in the cheek for storing food, is peculiar to the Cercopithecidæ; the other, the presence of saccular folds in the wall of the stomach—to give increased digestive surface and storage-room for the diet of leaves on which these monkeys subsist—is found only in the Semnopithecidæ (Presbytidae). These three special characteristics suggest that the Cynomorpha are descended from some extinct type of monkey resembling the Cebidæ and the lemurs in having no ischial callosities, no cheek pouches, and a simple stomach. But since there is no proof as yet of the former existence of Platyrrhine monkeys in the Old World, where the Cynomorpha were beyond doubt evolved, there is no reason to think that the latter are modified descendants of the former. All that can be said is that possibly the two groups trace their descent from some extinct Old World primate combining some of the characters of both and linking them to the lemurs.

Palæontology supplies no data to make further discussion of this question profitable. Nevertheless it proves that the Cercopithecidæ were formerly much more widely distributed than at present. Some of the fossil forms belong to the extinct, some to existing genera. Of the extinct forms, the most important are Mesopithecus, of which the typical species (*M. pentelici*) inhabited European forests in Pliocene times, and is said to have had a skull like that of the langurs (*Presbytes*), and the remainder of the skeleton like that of the macaque (*Macacus*); Dolichopithecus, which lived in France at the same period, was also akin to the Semnopithecidæ; while the older Oreopithecus, from the Middle Miocene of Italy, was a large, powerful monkey, combining to a certain extent the skull characters of some Cercopithecidæ and Simiidæ. Referable to existing genera are fossil remains of baboons (*Papio*), showing that this genus inhabited India in Lower Pliocene and Pleistocene times, and also Algeria at the latter period. Abundant remains of *Macacus* attest the existence of this monkey in Central and South Europe and India as far back as the Pliocene. Langurs (*Presbytes*) lived in the forests of the Upper Pliocene in France and Italy, as well as in North India, where they occur at the present day; while the essentially African guereza (*Colobus*) is represented by an extinct species in Miocene beds in Bavaria.

THE EVOLUTION OF THE LEMURS, MONKEYS, AND APES

The Cynomorpha, like lemurs and Cebidæ, are essentially quadrupedal primates, adapted for climbing trees or rocks. Their hind limbs are usually longer, and, apparently, never actually shorter than the fore limbs. They are able to stand erect, but very seldom walk on their hind legs, though they can be taught to do so. When on the ground, they habitually walk and run like ordinary four-footed mammals. All the species, including even the heavily-built baboons, can leap to a greater or less extent, some of the more lightly-built forms quite equalling typical lemurs in this respect; and all the strong leapers possess long tails. The thumb is shorter, more opposable, and less like the other digits than it is in the Platyrrhini and lemurs, but it is never a very proficient organ of prehension. The nails, especially of the feet, are, with the exception of that of the great toe, often compressed and claw-like.

The Presbytidae, resembling the hypothetical common ancestor of the family in the absence of cheek pouches, but differing from it in possessing a complicated stomach, are represented by genera in South-eastern Asia and Tropical Africa. All are active climbers and powerful jumpers, furnished with long tails. The langurs (*Presbytes*) of India and Malaysia may be regarded as a generalised type of the subfamily. The most aberrant and specialised types are the Bornean proboscis monkey (*Nasalis*), which has a larger nose even than man; and the guerezas, which have lost the first digit, or thumb, of the hand, exhibiting in this respect analogy with the spider monkeys among the Cebidæ.

Much more varied in appearance and structure than the Presbytidae are the Cercopithecidae, which differ from the hypothetical ancestral form in possessing cheek pouches, but resemble it in the simple structure of the stomach. Broadly speaking, these monkeys are divisible into four groups, known as guenons (*Cercopithecus*), mangabeys (*Cercocebus*), macaques (*Macacus*), and baboons (*Papio*).

The first two genera, confined to Africa, contain species differing from each other in characters of comparatively minor importance, all being long-tailed, active monkeys, principally of arboreal habits. Much more diversified in accordance with different conditions of existence are the macaques and baboons. Both of these groups contain species

which are largely terrestrial and have the tail shortened, or sometimes reduced to a stump-like vestige, exhibiting in this respect marked deviation from the primitive primate stock. Among the macaques the almost tailless Barbary ape (*M. inuus*), which inhabits the rocks of Gibraltar and Morocco, is a good illustration of this phenomenon; and similar suppression of the tail is exhibited by the two West African baboons, the mandrill (*P. maimon*), and the drill (*P. leucophaeus*). The baboons, as a whole, also show marked specialisation in the immense development of their jaws, the arched carriage of the tail, when present, their long fore limbs and well-developed thumbs. These facts,

coupled with their great intelligence, give them, perhaps, the right to be regarded as the "highest" of the Old World monkeys, though in the opinion of some authors they are the "lowest."

The second group of the Catarrhini, the Anthropomorpha, containing the single family the Simiidae, comprising the anthropoid apes, or gibbons, orangutans, gorillas, chimpanzees, and man, has many points in common with the Cynomorpha. But although they stand on a higher evolutionary plane in the sense of being further from the Platyrrhine type, it is quite certain they are not descended from any existing cynomorphous monkey nor from any extinct form which, if living, could be classified either with the Cercopithecidae or Presbytidae. They have neither the sacculated stomach of the latter nor the cheek pouches of the former, and the cæcum of the intestine is reduced in bulk terminally to form the narrow coiled tube called the vermiform appendix. The

breastbone is flattened from before backwards; there is no external tail, and, except in man, the fore limbs are much longer than the hind limbs.

On the difficult question of the descent of the Simiidae, palæontological records are too incomplete to throw much light. Some of the extinct forms, which are based, for the most part, upon teeth or other fragments of the skeleton show affinity with existing apes; others are less closely related to them, and even approach the human species in certain particulars. For example, *Pliohylobates*, from the Miocene of Europe, was related to the gibbons, but exceeded any existing species in size. *Pliopithecus*, also from the European



THE SILKY MARMOSET

Miocene, was likewise akin to the gibbons. *Palæopithecus*, from Pliocene beds of North India, on the contrary, was very closely allied to the chimpanzees (*Anthropopithecus*); and a molar tooth from the same strata has been regarded as belonging to an orang-utan (*Simia*). On the other hand, *Dryopithecus*, which inhabited the forests of South and Central Europe, was a strongly-built, perhaps gorilla-like, ape, with jaws recalling those of the *Cercopithecidae* in structure, and with other characters showing more affinity to man than was exhibited by any other Tertiary ape hitherto discovered. *Griphopithecus*, based upon some teeth, was of doubtful affinities; while *Anthropodus* showed points of resemblance both to *Dryopithecus* and to man in the structure of its teeth.

Thus, some of the fossil *Simiidae* exhibit remote and perplexing affinities to the *Cynomorpha*, on the one hand, and to man on the other; and since there are no strong reasons for believing that any of them is on the direct line of descent of these types, the points of resemblance in question must be probably regarded as due to inheritance from a common Catarrhine stock, whence the *Cynomorpha* and *Anthropomorpha* have been evolved along independent lines.

From the habits and characters of existing apes it is possible to form a conception of the general features of their ancestral type. On comparing the living animals with the *Cynomorpha*, the first fact to arrest attention is the great difference they exhibit in capacity or method of climbing. It would be wrong to say that the *Simiidae*, as a whole, are inactive climbers, because few primates excel the gibbons (*Hylobates*) in arboreal agility. Nevertheless, their method of passing from branch to branch is widely different from that of the *Cynomorpha*. The latter resemble the lemurs and marmosets in having the propelling power in their hind quarters. In true quadrupedal fashion, they leap from one branch, stiffen and extend the tail in the air, and alight on the upper side of another, first with their hands, then with their feet.

A gibbon, on the contrary, has leaping powers of the feeblest kind, and when he passes from branch to branch, launches into the air with a weak "take off," and with long arm upstretched catches the bough aimed at, swinging his body beneath it. If he wishes to alight on it, he maintains the hold of his hand, and the weight of his body carries him round and up the other side of the branch, so that he comes down upon it in a sitting or standing posture. If, on the contrary, he wishes to pass on from the second branch, he quits his hold as his body passes beneath and is carried by its momentum and a jerk of the arm towards the third branch, which he grasps with the other hand. Now, this "swinging" method of the gibbon and the "leaping" method of the cynomorphous monkey are equally efficient means of speedily traversing a forest; and it is impossible to believe that one method has been changed directly for the other. A gibbon can no more leap with its hind legs like a mangabey or

langur than either of the latter can swing with its arms like a gibbon. The gibbon's method is unique and not derivable from the other; but the monkey's method has been inherited unchanged from some long-tailed lemuroid ancestor. And since the gibbons are descended remotely from the same stock, the conclusions seem unavoidable that their immediate ancestor had lost the primitive leaping power and that the peculiar acrobatic style of the gibbons has been specially learnt by them.

Turning to the other apes, they are good, but, on account of their weight, slow climbers when pitted against the Old World monkeys. The orang-utan is, of the three, the best adapted for arboreal life, and the least fitted for life on the ground. His thumb and great toe are shorter than in the gorilla and chimpanzee; but his hands and feet are of great length with powerful, hook-like fingers and toes, the great toe being set far back on the foot so as to grasp branches big and strong enough to support the animal's weight. The more human hand and foot of the chimpanzee and gorilla confer greater facility in traversing flat ground. When moving over the ground these three great apes either walk on all four limbs, after the manner of monkeys, or swing their bodies forward between their long arms, using them as crutches and resting on the knuckles of the hand. This method of walking is never apparently practised by ordinary monkeys in good health.

Orang-utans seldom, if ever, stand erect without support from the arms. Chimpanzees occasionally do so (page 169), but very rarely walk in that attitude. Gorillas, on the contrary, can both stand and walk upright, and do so when angered or excited; but, like chimpanzees and orang-utans, they resort to the primitive quadrupedal method when retreating from danger. Terrestrial progress in the gibbons is very different. They never actually rest on the hands at all, but run or walk upright on their legs, using their arms as balancers, and resting on the flat of the foot, supported mainly by the heel and large laterally projecting great toe. They move along horizontal branches in the same way. Thus, in their method of swinging from branch to branch, as well as in their method of traversing flat ground, the gibbons differ more from the monkeys and ordinary lemurs than do the other apes. The latter, however, it must be added, are practically incapable of leaping from bough to bough as the monkeys do, the weakness of the hind legs, the great weight of the body, and the absence of the tail making it almost impossible for them to steady themselves and balance on the upper side of a branch when alighting upon it. They therefore climb by reaching from branch to branch with their long arms and strong hands, swinging from one to another with the body suspended, when necessary, in mid-air. Their method of climbing, in fact, is much the same as that of the gibbons, due allowance being made for the fact that they never apparently venture to let go the grasp of one hand until the other is securely placed. These are useful facts to remember in discussing the question of the origin of apes and man.

THE EVOLUTION OF THE LEMURS, MONKEYS, AND APES

In the primates, reduction of the tail either accompanies the adoption of a terrestrial mode of life by species whose ancestors were arboreal—like the drills, mandrills, and rock macaques—or it accompanies alteration in the mode of climbing, the swift-leaping method being changed for the slow-creeping method as in the slow lemurs (*lorises* and *pottos*), or for the upright method of climbing about trees exhibited by the *endrin*as. Now, in the case of the *endrin*as and slow lemurs, the reduction of the tail has accompanied the adoption of a more complete arboreal mode of life than is exhibited by their more generalised ancestors, of which the true lemurs and the *galagos* are living representatives.

But the evidence supplied by the structure and habits of anthropoid apes, the total absence of the external tail, their peculiar method of progression on the ground, and of movement through forests, suggest their descent from ancestors which for long ages had lost more or less the characteristic activity, manifested by running on all-fours and of leaping from branch to branch, of the partly arboreal, partly terrestrial, but essentially quadrupedal cynomorphous monkeys, but which, while adopting to a great extent a terrestrial mode of life, had retained the power of ascending trees for safety from enemies, and for the purpose of feeding.

From a primitive Catarrhine stock of this nature, tailless, but with ischial callosities, with opposable great toe, and with the limbs probably subequal in length, it is not unlikely—perhaps, indeed, it is probable—that the anthropoid apes and man are descended, each genus having departed from it in varying degrees along its own line of evolution. Moreover, since both in gibbons and in man, the two types of this group which differ most widely from each other, we find bipedal progression with an upright attitude the sole or habitual method of traversing the ground, and since the same habit is practised, though in a less complete and perfected form, by the gorilla—which structurally lies midway between the two—it is not unreasonable to assume that erect walking was originated by this hypothetical ancestor. No doubt, however, it retained at the same time the ordinary quadrupedal walk of monkeys and baboons.

Great increase in the length of the arms is one marked feature in which all these anthropoid apes have deviated from this type. It is owing to the length of these limbs, as compared with the body and legs, that they can be used as crutches by chimpanzees, gorillas, and orang-utans in terrestrial progression. In the gibbons they are not so used, because the better-developed legs are capable of supporting with comparative ease the lightly-built

body. It is improbable, however, that their usefulness as crutches has been the guiding factor in the development of the arms. For this we must look probably to their proficiency as climbing organs. It is quite clear that they are admirably adapted for enabling heavily-built animals, which cannot leap, to pass with speed and safety from branch to branch, or tree to tree, without quitting their hold. Let it be remembered, too, in this connection, that the best gymnasts amongst men are those who have relatively long and strong arms, and short, lightly-built legs, men who approach the anthropoid apes in these respects.

The apes which depart most from our hypothetical ancestral type in arboreal activity are the gibbons and orang-utans, both in their own way being exceedingly skilful climbers. They also depart most widely from it in terrestrial activity; but whereas in the orang-utan the deviation has taken the direction of loss of activity, in the gibbons the incipient power of standing and walking erect, postulated for that type, has been greatly developed, very likely as an accompaniment of loss of bodily bulk and weight; for the unique power of swinging from tree to tree possessed by these lightly-built apes suggests its origin from the slower, more careful method exhibited by their bulkier relatives. If this be so, the comparatively small size of the gibbons is due to dwarfing, and, like the habit in question, is a secondarily acquired attribute. Structural adaptation to special arboreal habits has carried the



CHIMPANZEE IN AN UPRIGHT ATTITUDE
Photograph, Carl Hagenbeck

gibbons and orang-utans further from the primitive Catarrhine stock whence apes and men originated than the 'chimpanzees and gorillas have been carried. Hence it comes about that the two former apes, and especially the gibbons, are structurally less like man than the two latter. Of these, the chimpanzee, which has the arms shorter in proportion to the legs than is the case in any other anthropoid ape, and presents other characters in which it is more akin to man, moves with greater ease and speed over the ground in the ordinary quadrupedal walk of monkeys and baboons—though using, as a rule, the knuckles instead of the palm of its hand—than any other ape. Thus, man's nearest relation among the apes retains in a marked manner the mode of walking on all-fours, believed to have been practised by the hypothetical primitive stock whence the genera of this group emanated; and the gorilla, with nearly as many human characters as the chimpanzee, perhaps shows in an almost unaltered form the powers of standing and walking erect exhibited by that type.

R. I. Pocock

CLASSIFICATION OF THE PRIMATES

ALTHOUGH every naturalist has his own ideas about the classification of the animal kingdom, and no single scheme can be said to command universal assent, yet differences arise on questions of detail rather than on matters of principle or on the broad lines of demarcation. In the HARMSWORTH NATURAL HISTORY the plan has been adopted of presenting a good working schedule which shall show the place of those animals, whether high or low in the kingdom, which have called for mention in the text. A complete classification, however, is not practicable, since it would involve neither more

nor less than a catalogue of every species or race of living creature, and occupy the whole of a large volume. As a helpful compromise, it has been arranged to give, at the beginning of each order of the vertebrate division, a classification thereof, coming as far down as the species described, but avoiding those refinements of grouping that are frequently irritating in themselves, and, in any case, of value only to the expert. So far as they have been ascertained, both the popular and scientific names of animals are cited. We begin with the classification of the first order, that of the Primates.

ORDER I.

MAN, APES, MONKEYS, AND LEMURS—PRIMATES

SUBORDER 1

Man, Apes, and Monkeys—Anthropoidea

FAMILY 1

Man—Hominidae

GENUS

Man (fossil)—*Homo primigenius*

Man—*Homo sapiens*

FAMILY 2

Man-like Apes—Simiidae

GENUS 1

Chimpanzee and Gorilla *Anthropithecus*

SPECIES

Chimpanzee *Anthropithecus troglodytes*

Gorilla *a. gorilla*

GENUS 2

Orang-utan—*Simia*

SPECIES

Orang-utan *Simia satyrus*

GENUS 3

Gibbons—*Hylobates*

SPECIES

Siamang *Hylobates syndactylus*

White-handed gibbon *h. lar*

Hulock *h. huloek*

Hainan gibbon *h. hainanus*

Agile gibbon *h. agilis*

Malay gibbon *h. rafflesi*

Crowned gibbon *h. pileatus*

Wou-wou, or silvery gibbon *h. leuciscus*

FOSSIL APES

Man-ape *Pithecanthropus erectus*

Miocene ape *Pliopithecus*

Tree ape *Dryopithecus*

Oligocene ape *Propithecus*

FAMILY 3

Old World Monkeys and Baboons—*Cercopithecoidea*

GENUS 1

Langurs—*Semnopithecus*

SPECIES

Hanuman, or true langur *Semnopithecus entellus*

Himalayan langur *s. schistaceus*

Madras langur *s. priamus*

Banded langur *s. femoralis*

Negro langur *s. maurus*

Crested langur *s. cristatus*

Nilgiri langur *s. johni*

Purple-faced langur *s. cephalopterus*

Capped langur *s. pileatus*

Red-bellied langur *s. chrysogaster*

Dusky langur *s. obscurus*

Phayre's langur *s. phayrei*

Hose's langur *s. hosei*

Douc *s. nemæus*

GENUS 2

Snub-nosed Monkeys—*Rhinopithecus*

SPECIES

Snub-nosed monkey *Rhinopithecus roxellanae*

Slaty snub-nosed monkey *r. bieti*

GENUS 3

Proboscis Monkeys—*Nasalis*

SPECIES

Proboscis monkey *Nasalis larvatus*

GENUS 4

Guereza Monkeys—*Colobus*

SPECIES

Black-and-white guereza *Colobus guereza*

Black guereza *c. satanas*

King guereza *c. polycomus*

Ursine guereza *c. ursinus*

Angola guereza *c. angolensis*

White-thighed guereza *c. villerosus*

Bay guereza *c. ferrugineus*

Crested guereza *c. cristatus*

GENUS 5

Guenon Monkeys—*Cercopithecus*

SPECIES

Malbrouck monkey *Cercopithecus cynosurus*

Vervet monkey *c. pygerythrus*

Mozambique monkey *c. rufoviridis*

Grivet monkey *c. æthiops*

Green monkey *c. sabæus*

Patas monkey *c. patas*

Nisnas monkey *c. patas pyrrhonotus*

Sykes's monkey *c. albogularis*

Black-bellied monkey *c. leucampyx*

Mona monkey *c. mona*

Bearded monkey *c. pogonias*

Erleben's monkey *c. grayi*

Wolf's monkey *c. wolff*

Campbell's guenon *c. campbelli*

Burnett's guenon *c. burnetti*

Dent's guenon *c. denti*

Moustache monkey *c. cephus*

Red-eared monkey *c. erythrotis*

Hocheur monkey *c. nictitans*

Lesser white-nosed monkey *c. petaurista*

Diana monkey *c. diana*

Rolloway monkey *c. rolloway*

GENUS 6

Mangabeys, or White-eyelid Monkeys—*Cercocetus*

SPECIES

Sooty mangabey *Cercocetus fuliginosus*

White-collared mangabey *c. collaris*

White-crowned mangabey *c. lunulatus*

Crested mangabey *c. albigena*

Orange-bellied monkey *c. chrysogaster*

Hagenbeck's monkey *c. hagenbecki*

GENUS 7

The Macaque Monkeys—*Macacus*

SPECIES

Bonnet monkey *Macacus sinicus*

Toque monkey *m. pileatus*

Crab-eating monkey *m. cynomolgus*

Lion-tailed monkey *m. silenus*

Bengal monkey *m. rhesus*

Chinese rhesus *m. lasiotis*

Himalayan macaque *m. assamensis*

Pig-tailed monkey *m. nemestrinus*

Burmese pig-tailed monkey *m. leoninus*

Brown stump-tailed monkey *m. arctoides*

Tibetan stump-tailed monkey *m. tibetanus*

Moor macaque *m. maurus*

Japanese macaque *m. fuscatus*

Magot, or Barbary macaque *m. inuus*

GENUS 8

Black Ape—*Cynopithecus*

SPECIES

Black ape *Cynopithecus niger*

GENUS 9

Gelada Baboon—*Theropithecus*

SPECIES

Gelada *Theropithecus gelada*

GENUS 10

True Baboons—*Papio*

SPECIES

Mantled baboon *Papio hamadryas*

Chacma baboon *p. porcarius*

Anubis baboon *p. anubis*

Yellow baboon *p. cynocephalus*

Thoth baboon *p. thoth*

Guinea baboon *p. sphinx*

GENUS 11

Mandrill and Drill—*Maimon*

SPECIES

Mandrill *Maimon mormon*

Drill *m. leucophaeus*

Fossil Old World Monkeys and Baboons

Pliocene macaque *Macacus prisens*

Grecian monkey *Mesopithecus pentelici*

Mountain ape *Oreopithecus bamboli*

FAMILY 4

American Monkeys—*Cebidae*

GENUS 1

Sapajous, or Capuchin Monkeys—*Cebus*

SPECIES

White-cheeked sapajou *Cebus lunatus*

Brown sapajou *c. fatuellus*

Slender sapajou *c. flavus*

Tufted sapajou *c. cirrifer*

Weeper sapajou *c. capucinus*

White-fronted sapajou *c. albifrons*

White-throated sapajou *c. hypoleucus*

Smooth-headed sapajou *c. monachus*

Crested sapajou *c. robustus*

GENUS 2

Woolly Monkeys—*Lagothrix*

SPECIES

Humboldt's woolly monkey *Lagothrix humboldti*

GENUS 3

Woolly Spider Monkeys—*Brachyteles*

SPECIES

Woolly spider monkey *Brachyteles arachnoides*

GENUS 4

Spider Monkeys—*Ateles*

SPECIES

Red-faced spider monkey *Ateles paniscus*

Chameck *a. suopentadactylus*

Black-faced spider monkey *a. ater*

Grizzled spider monkey *a. grisescens*

Hooded spider monkey *a. cucullatus*

Chuva *a. magnatus*

Black-handed spider monkey *a. geoffroyi*

White-bellied spider monkey *a. vellerosus*

Variegated spider monkey *a. variegatus*

GENUS 5

Douroucolis—*Nyctipithecus*

SPECIES

Three-banded douroucolis *Nyctipithecus trivirgatus*

Feline douroucolis *n. felinus*

Lemurine douroucolis *n. lemurinus*

GENUS 6

Squirrel Monkeys—*Chrysothrix*

SPECIES

Common squirrel monkey *Chrysothrix sciurea*

Short-tailed squirrel monkey *c. usta*

Black-tailed squirrel monkey *c. boliviensis*

CLASSIFICATION OF THE PRIMATES

GENUS 7

Titi Monkeys—*Callithrix* SPECIES

Red titi *Callithrix cuprea*
Collared titi *c. torquata*
White-chested titi *c. amicta*
Moloch titi *c. moloch*
Reed titi *c. donacophila*
Black-fronted titi *c. nigrifrons*
Brown titi *c. brunnea*
Black-handed titi *c. melanochira*

GENUS 8

Saki Monkeys—*Pithecia* SPECIES

White-headed saki *Pithecia leucocephala*
Humboldt's or hairy saki *p. monachus*
Red-backed saki *p. chiropotes*
Black saki, or cuxio *p. satanas*
White-nosed saki *p. albinasa*

GENUS 9

Uakari Monkeys—*Uacaria* SPECIES

Bald uakari *Uacaria calva*
Red-faced uakari *u. rubicunda*
Black-headed uakari *u. melanocephala*

GENUS 10

Howling Monkeys—*Alouatta*, or *Mycetes* SPECIES

Black howler *Alouatta nigra*
Yellow-handed howler *a. belzebul*
Vera Cruz howler *a. villosa*
Red or golden howler *a. seniculus*
Brown howler *a. ursina*
Mantled howler *a. palliata*

Extinct American Monkeys

Miocene monkey *Homunculus*
Pleistocene monkey *Protopithecus*

FAMILY 5

Marmosets—*Hapalidæ*

GENUS 1

Short-tusked Marmosets—*Hapale* SPECIES

Ouistiti marmoset *Hapale jacchus*
White-necked marmoset *h. albicollis*
Black-eared marmoset *h. penicillata*
White-eared marmoset *h. aurita*
White-shouldered marmoset *h. humeralifer*
Silver marmoset *h. chrysolenus*
Black-tailed marmoset *h. melanura*
Pigmy marmoset *h. pygmaea*

GENUS 2

Long-tusked Marmosets, or Tamarins—*Midas* SPECIES

Negro tamarin *Midas ursulus*
Red-handed tamarin *m. rufimanus*

Brown-headed tamarin *m. fuscicollis*
Black-and-red tamarin *m. rufoniger*
Deville's tamarin *m. weddelli*
Moustached tamarin *m. labiatus*
Red-bellied tamarin *m. rufiventer*
Pinché *m. edipus*
Geoffroy's marmoset *m. geoffroyi*
Silky marmoset *m. rosalia*
Lion marmoset *m. leoninus*
Golden-headed marmoset *m. chrysomelas*

SUBORDER 2

Lemuroids—*Lemuroidea*

FAMILY 1

Lemurs—*Lemuridæ*

GENUS 1

Indri Lemur—*Indris*

SPECIES

Indri *Indris brevicaudata*

GENUS 2

Sifakas—*Propithecus*

SPECIES

Diademed sifaka *Propithecus diadema*
Verreaux's sifaka *p. verreauxi*
Crowned sifaka *p. coronatus*

GENUS 3

Avahi Lemur—*Avahis*

SPECIES

Avahi, or woolly lemur *Avahis laniger*

GENUS 4

True Lemurs—*Lemur*

SPECIES

Ring-tailed lemur *Lemur catta*
Mongoose lemur *l. mungos*
Black lemur *l. macaco*
Ruffed lemur *l. varius*
Red lemur *l. ruber*
Red-bellied lemur *l. rubriventer*
Sooty lemur *l. nigerrimus*

GENUS 5

Gentle Lemur—*Hapalemur*

SPECIES

Grey gentle lemur *Hapalemur griseus*

GENUS 6

Weasel Lemurs—*Lepidolemur*

SPECIES

Weasel lemur *Lepidolemur mustelinus*
Red-tailed weasel lemur *l. ruficaudatus*
Edwards' weasel lemur *l. edwardsi*
Small-toothed weasel lemur *l. microdon*

GENUS 7

Mouse Lemurs—*Chirogaleus*

SPECIES

Fork-headed mouse lemur *Chirogaleus furcifer*
Lesser mouse lemur *c. minor*

Coquerel's mouse lemur *c. coquereli*
Dwarf mouse lemur *c. smithi*
Brown mouse lemur *c. mili*

FAMILY 2

Aye-Aye—*Chiromyidæ*

GENUS

Aye-aye—*Chiromys*

SPECIES

Aye-aye *Chiromys madagascariensis*

FAMILY 3

Galagos and Lorises—*Loridæ*

GENUS 1

Galagos—*Galago*

SPECIES

Great galago *Galago crassicaudata*
Monteiro's galago *g. montei*
Garnett's galago *g. garnetti*
Allen's galago *g. alleni*
Pale-coloured galago *g. pallidus*
Senegal galago *g. senegalensis*
Senar galago *g. senarensis*
Demidoff's galago *g. demidoffi*

GENUS 2

Slow Loris—*Nycticebus*

SPECIES

Slow loris *Nycticebus tardigradus*

GENUS 3

Slender Loris—*Loris*

SPECIES

Slender loris *Loris gracilis*

GENUS 4

Pottos, or African Slow Lemurs—*Perodicticus*

SPECIES

Bosman's potto *Perodicticus potto*
Edwards's potto *p. edwardsi*
Bates's potto *p. batesi*
Uganda potto *p. ibeanus*

GENUS 5

Awantibos—*Arctocebus*

SPECIES

Awantibo *Arctocebus calabarensis*
Golden awantibo *a. aureus*

FAMILY 4

Tarsiers—*Tarsiidæ*

GENUS

Tarsiers—*Tarsius*

SPECIES

Malay tarsier *Tarsius spectrum*
Philippine tarsier *t. fuscus*

Fossil Lemurs

Microchoerus

Adapis

Archæolemur

Megaladapis



A GROUP OF HANUMAN MONKEYS

From a photograph by Gambier Bolton, reproduced by permission of the Autotype Company, 74, New Oxford Street London, W.

EXAMPLES OF THE MAN-LIKE APES



A YOUNG CHIMPANZEE



TWO YOUNG GORILLAS



A BABY ORANG-UTAN AND TWO BLACK BOYS



YOUNG ORANG-UTAN



SILVERY GIBBON

From photographs by permission of Carl Hagenbeck, Lewis Medland, and W. S. Berridge

ORDER I. APES, MONKEYS, LEMURS

GENERAL SKETCH OF THE MAN-LIKE APES

By R. LYDEKKER

EVERYBODY knows what an ape or a monkey is, and the proverb "mischievous as a monkey" reveals the estimation in which the latter animal is commonly held. The more or less human-like form, the frequent tendency to assume an upright position, coupled with their hand-like feet, would be amply sufficient to distinguish the group to which these animals belong from all others, were it not for the circumstance that there are the less familiar creatures termed lemurs, which, while evidently related to monkeys, yet differ from them in so many respects as to render it almost or quite impossible to give any characteristics which will absolutely distinguish the order to which they belong from all others. This is, however, a difficulty with which the zoologist has often to put up with, and to make the best of.

That the higher apes are closely related in their bodily structure to man is obvious to all, and it is a fact that the differences between some of these apes and man are, from a purely anatomical point of view, of far less importance than those by which the lower monkeys are separated from the higher apes. It has, indeed, been attempted to show that apes and monkeys are sharply distinguished from man by the circumstance that while man is two-handed, apes and monkeys are four-handed. The difference between the foot of one of the larger apes and that of man is, however, merely one of degree, and is much less than that between the apes and the lowest representatives of the order, as is well shown in the illustration on page 174, which exhibits the various forms assumed by the hand and foot of these animals.

Although the larger apes are those which come nearest to man in their general organisation, yet the strong ridges on the skulls of the adults, and the consequent overhanging and prominent eyebrows, give them an expression which, at the best, is but a gross caricature of the human countenance. It is, however, in the young of these animals, in which the ridges on the skull are much less developed, and the tusks, or canine teeth, of the males do not attain the dimensions reached in the adult state, that we find a much more human-like cast of expression. Moreover, some of the smaller apes, in which the great ridges on the skull are never developed, approach much more nearly in the shape of their skulls to the human type. The larger apes are, indeed, repulsive animals in the adult condition; and it is usually only the smaller kinds of monkeys which are kept as pets.

Most of the Primates, with the exception of man, are adapted for living in warm climates, and are never found in regions which have not at least a hot summer. Some of them are, however, capable of withstanding a considerable amount of winter cold; and it is no uncommon sight in the outer ranges of the Himalaya to see troops of monkeys leaping from bough to bough of the snow-laden pines.

Moreover, two species of monkeys inhabit the elevated regions of North-eastern China, where the winter is intensely cold. Excepting the apes found on the Rock of Gibraltar, which must either have reached their present habitation when Spain was united to Africa, or have been introduced by man at a later period, none of the Primates is found in Europe; they occur, however, throughout the warmer regions of the rest of the globe, with the exception of the Australian region; but whereas all the apes and monkeys of the Old World belong to two well-marked families, those of the New World represent two other families closely allied to one another, but markedly different from both those of the Old World. The lemurs, as we shall see later, are now wholly Old World forms, and are especially characteristic of Madagascar, although also represented in India, and on the continent of Africa, as well as in certain islands. In past times, however, lemurs were distributed over the greater part of the globe; and monkeys even roamed over the ancient forest-lands of Essex, as is proved by the discovery of a few remains in the Brick-earth of Ilford; and they were also abundant over the more southerly regions of Europe.

Nearly the whole of the Primates are adapted for a more or less completely arboreal life, most of them being inhabitants of forest regions. Aided by their hand-like feet, all of them are expert climbers, and many, like the Indo-Malay gibbons and the South American spider-monkeys, rarely leave the trees, leaping from bough to bough, and thus from tree to tree, far above the heads of the travellers below, to whom their presence is made known only by their continual howling or chattering. The climbing powers of many South American monkeys are largely aided by their prehensile tails, which serve the purpose of a fifth limb. Owing to the warmth of the regions in which most of them dwell, no monkeys ever hibernate. Contrary, however, to what is often supposed to be the case, several of the smaller species are expert swimmers, and will fearlessly cross comparatively wide rivers.

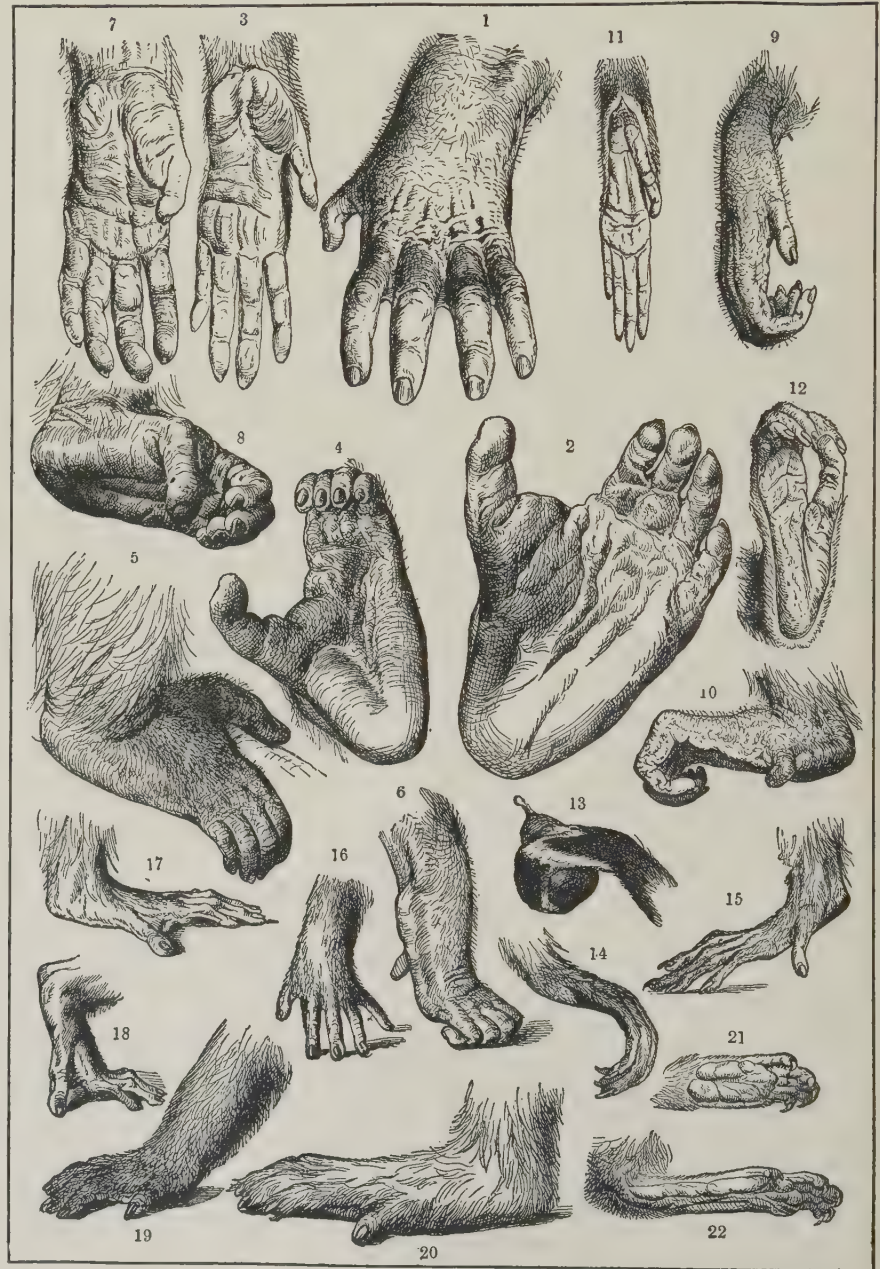
Summarising some of the more characteristic features which distinguish the order as a whole from other mammals, it may be mentioned in the first place that the hand and the foot are, as a rule, furnished respectively with five fingers and five toes, although in a few instances the thumb is wanting. Then, again, the hand is always adapted to act as a grasping organ, and, save in man, the same is the case with the foot, though it has been discovered that the foot of the newly-born human infant displays distinct traces of having been originally a grasping organ. In those cases where the hand attains its most perfect development, the thumb can be opposed to the fingers, but in some of the lower species this action

is only possible in a limited degree. The great toe is, in a similar manner, opposable to the other toes, although in man, as is shown in the figure of his skeleton (page 148), this action has been more or less completely lost, and the bones of this toe lie parallel to those of the other toes. In this respect the foot of man is markedly different from that of the gorilla and the other man-like apes. With the exception of the orang-utan, in which the great toe is often devoid of any trace of such appendage, all the fingers are furnished with nails. In the higher species these nails are of a flattened shape in all the digits; and this flatness is always characteristic of the nail of the great toe, although the other toes of the lower species have curved nails. In order to form an efficient support for these nails, the bones of the terminal joints of the digits, with the exception of the index finger of the lemurs, are transversely flattened out, and are thus very different from those of rodents and carnivores. That the hand and foot should have perfect freedom of movement, it is, of course, necessary that the bones of the forearm and the lower part of the leg should remain completely separate from one another; and, as may be seen from the figure of the human limbs (p. 142), the radius and ulna in the forearm, and the tibia and fibula in the leg, are both equally well developed and capable of motion upon one another. Another important point as regards the free use of the arms is the presence of complete collarbones, which are always well developed in apes and monkeys, as they are in man.

On looking once more at the figure of the skeletons of man and the gorilla (p. 148), it will be seen that in the skull the sockets, or orbits, of the eyes are completely surrounded by a ring of bone, and that the sockets themselves look almost directly forwards. This complete bony ring round the eye-sockets at once serves to distinguish the skulls of all the Primates from those of most of the Carnivora.

In correlation with the herbivorous habits of the majority of the species, the teeth of the Primates are adapted for

grinding; the cheek-teeth have broad, flattened crowns, which may be either, as in man, surmounted by tubercles or by transverse ridges. Except in one family of American monkeys, there are always three molar teeth in each side of both jaws, the last of which corresponds with the human "wisdom tooth"; and these molar teeth are invariably larger and more complicated than the premolars. Very generally, as in man, the number of the latter teeth is reduced to two on each side, and no living member of the order has more than three of these teeth. Frequently, and, indeed, invariably in the apes and



HANDS AND FEET OF APES AND MONKEYS

1, 2, Gorilla; 3-8, Chimpanzee; 9, 10, Orang-utan; 11-13, Gibbon; 14, 15, Guereza; 16-18, Macaque; 19, 20, Baboon; 21, 22, Marmoset

GENERAL SKETCH OF THE MAN-LIKE APES

monkeys, there are but two incisor teeth on each side of both the upper and the lower jaws.

With the single exception of the curious aye-aye of Madagascar, there are at least two mammæ situated on the breast of the females of all members of the order.

These, then, are the chief common characters possessed by apes and monkeys, on the one hand, and lemurs, on the other; but, such as they are, they are considered of sufficient importance by many naturalists to justify the inclusion of both groups in a single order. The two groups constitute, however, separate suborders, of which the first is termed the Anthroipoidea, and the second the Lemuroidea.

Apart from man himself, the man-like apes include the largest representatives of the Primates. They are found only in the dense forests of the warmest and dampest regions, and are all characterised by their strikingly human-like form, although none habitually walks solely on the hind limbs without obtaining additional support from the long arms.

In all the larger species the resemblance to man is more marked in the young than in the adult; while in the adult the human characteristics are more pronounced in the female than the male. Dr. R. Hartmann, who has devoted much attention to these apes, observes, for instance, that "in the gorilla, the chimpanzee, and the orang-utan, the external form is subject to essential modifications, according to the age and sex. The difference between the sexes is most strongly marked in the gorilla, and these differences are least apparent in the gibbons. When a young male gorilla is compared with an aged animal of the same species, we are almost tempted to believe that we have to do with two entirely different creatures. While the young male still displays an evident approximation to the human structure, and develops in its bodily habits the same qualities which generally characterise the short-tailed apes of the Old World, with the exception of the baboon, the aged male is otherwise formed. In the latter case the points of resemblance to the human type are far fewer; the aged animal has become a gigantic ape, retaining, indeed, in the structure of his hands and feet, the characteristics of the Primates, while the protruding head is something between the muzzle of the baboon, the bear, and the boar. Simultaneously with these remarkable alterations of the external structure there occurs a modification of the skeleton. The skull of an aged male gorilla becomes more projecting at the muzzle, and the canine teeth have almost attained the length of those of lions and tigers. On the upper part of the skull, which is rounded in youth, great bony crests are developed on the crown of the head and on the occiput. The arches above the eye-sockets are covered with wrinkled skin, and the already savage and indeed revolting appearance of the old gorilla is thereby increased."

In all the man-like apes the number of the teeth is the same as in man himself—that is to say, there are on each side of both the upper and lower jaws two incisors, one canine, two premolars, and three molars; the formula thus being: $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{2}{2}, m.\frac{3}{3}$, making a total of 32 teeth. Not only do the teeth

agree in number with those of man; but, with the exception of the great size of the tusks, or canines, of the males, they likewise resemble them in structure. We are familiar with the form of our own molar teeth, which have wide crowns, with their angles rounded off, and surmounted by four main tubercles set somewhat obliquely to one another; and the molars of the man-like apes are of the same general type of structure (see figure on page 151). In the apes, however, the whole series of teeth does not present the horseshoe-like contour which is so characteristic of human teeth; but, on the contrary, the cheek teeth form nearly straight lines, having an angulated junction with the curved line of the front teeth.

None of these apes possesses the peculiar pouches in the cheeks occurring in many of the monkeys, and none of them has any trace of a tail. Moreover, the naked patches so often found on the buttocks of the other Primates are either absent, or, if present, are of very small size. All these animals agree, however, with monkeys, and thereby differ from man, in the great length of the arms as compared with that of the legs; this difference being clearly indicated in the figure of the skeletons of man and the gorilla (page 148). Another characteristic of the man-like apes shown in the same figure is the great breadth and flatness of the breastbone, or sternum, this being a feature in which they agree with man, and differ from baboons and monkeys. Then, again, some of the man-like apes differ from the latter and resemble man in the absence of a small bone occupying a central position in the wrist, and hence known as the centrale of the carpus.

In addition to the points already mentioned, man is distinguished from the man-like apes by the greater relative size of his brain and the portion of the skull in which it is contained, as compared with the face and muzzle. His canine teeth are, moreover, but little longer than the other teeth, and are thus quite unlike the huge tusks of the male gorilla and orang-utan. The great toe is also relatively longer, and is, at the most, only opposable in a very limited degree to the other toes. Indeed, the whole skeleton of man, as may be seen from the figure, is of a lighter and neater build, with certain peculiar curvatures of the lower part of the backbone, these permitting the assumption of the perfectly upright position without fatigue, and without need of any support from the arms, which do not reach below the middle of the thigh. Again, no ape has an ear modelled on the beautiful lines of that of the human species. The naked human body is not, however, a character which a naturalist would consider of any importance as distinguishing man from the apes.

The man-like apes are now restricted to the forest regions of the hottest parts of Asia and Africa; the chimpanzee and gorilla being exclusively African, the gibbons common to North-eastern India and Malaya, and the orang-utan solely Malayan. Chimpanzees and apparently orang-utans, however, formerly occurred in India, and gibbons and an extinct type at a somewhat earlier period in Europe, while the earliest-known member of the group is found in the Oligocene strata of Egypt. This

distribution indicates the former existence of an extensive forest tract connecting India and Malaya, by way of Arabia, with Equatorial Africa; the central part of this area being now either submerged or deforested. This explains the remarkable resemblances between the fauna of Southern India, Ceylon, and Malaya, on the one hand, and that of the forest region of Africa, on the other.

THE CHIMPANZEE

Of all the large man-like apes, the one which makes the nearest approach in bodily structure to man is the chimpanzee (*Anthropopithecus troglodytes*) of Western and Central Equatorial Africa, of which there are several geographical races. (See frontispiece.)

The chimpanzee has been long known in Europe; and it has, indeed, been considered that the so-called "gorillas" met with by the Carthaginians of Hanno's voyage in 470 B.C. on the rocky coasts of Sherboro Island, off Sierra Leone, were chimpanzees. According, however, to Winwood Reade, who travelled in Western Africa for the purpose of obtaining authentic information about the chimpanzee and the gorilla, the creatures seen and captured by Hanno's party were neither gorillas nor chimpanzees, but dog-faced baboons. Be this as it may, that the chimpanzee was known in Europe so far back as 1598 is proved by an account brought back from the Congo by a Portuguese sailor named Eduardo Lopez, and published at Frankfort by Pigafetta in his account of the Congo district. In 1613 there appeared, in Samuel Purchas's "Pilgrimage," the history of the wanderings of an English sailor named Andrew Battel, who travelled in the lower part of Guinea in 1590, and appears to have heard of or seen, not only the chimpanzee, which he designates the enjocko (a corruption of n'djekko or n'schego), but likewise the gorilla, which he calls the pongo.

Battel's account may be quoted at length, as follows: "There are two kinds of monsters common to the woods of Angola; the largest of them is called pongo in their language, and the other enjocko. The pongo is in all its proportions like a man (except the legs, which have no calves), but he is of gigantic height. The face, hands, and ears of these animals are without hair; their bodies are covered, but not very thickly, with hair of a dunnish colour. When they walk on the ground, it is upright, with the hands on the nape of the neck. They sleep on trees, and make a covering over their heads to shelter them from the rain. They eat no flesh, but feed on nuts and other fruits; nor have they any understanding beyond instinct. When the people of the country

travel through the woods, they make fires in the night, and in the morning when they are gone the pongos will come and sit round it till it goes out, for they do not possess sagacity enough to lay on more wood. They go in bodies to kill many negroes who travel in the wood. When elephants happen to come and feed where they are, they will fall on them, and so beat them with their clubbed fists and sticks that they are forced to run away roaring. The grown pongos are never taken alive, owing to their strength, which is so great that ten men cannot hold one of them. The young hang upon their mother's belly with their hands clasped about her. Many of them are taken by shooting the mothers with poisoned arrows."

From that date our knowledge of these animals has been gradually added to, although there is still room for fuller authentic accounts of their habits in a state of nature. Young chimpanzees are frequently brought alive to Europe and exhibited in zoological gardens, but they require great care and attention, and even with these almost invariably die after a few years or months from the effects of the climate, which generally show themselves in various organic affections, although not, as has been supposed, in the form of tubercular disease of the lungs.

In addition to certain distinctive features in the teeth, such as the relatively small size of the tusks, or canines, of the males, and the circumstance that the upper "wisdom tooth" is smaller than either of the two molars in advance of it, the typical chimpanzee may be distinguished from the gorilla by the fact that the males are but slightly larger than the females. The skull of the male chimpanzee is also characterised by the absence of the enormous bony ridges which overhang the sockets of the eyes in that of the gorilla; while in the lower jaw the length of the bony union between the two lateral branches is much less than in the latter. In both these respects the chimpanzee is decidedly nearer to man than is the gorilla; and a further approximation to the human type is presented by the relatively shorter arms, which in the perfectly upright posture only reach a short distance below the knee. The hands and feet also are longer and more slender than those of the gorilla, as may be seen by comparing Figs. 3-8 with 1 and 2 of the illustration on page 174. Moreover, as is the case in man, the middle finger is longer than any of the others; and although there is some degree of variation in the relative length of the thumb in different individuals, as a rule this digit reaches to the base of the first phalangeal joint of the index finger. The male chimpanzee does not usually exceed five feet



HEAD OF CHIMPANZEE

THE CHIMPANZEE

in height when full grown, and is thus considerably inferior in size to the male gorilla.

Dr. Hartmann remarks of the chimpanzee that, although the arched ridges above the eyes "are not so excessively prominent as in a gorilla of the same age, they are strongly developed, covered with wrinkled skin, and in this case also there is a species of eyebrow, stiff and bristly, with shorter hairs between. The large, wrinkled lids are furnished with thick eyelashes. A general physiognomical distinction between the gorilla and the chimpanzee consists in the fact that the bridge of the nose is shorter in the latter than in the former. In the chimpanzee this part of the organ is depressed, yet the depression is of a conical and convex form and is covered with a network of wrinkles of varying depth. In the chimpanzee the interval between the inner angle of the eye and the upper lateral contour of the cartilaginous end of the nose is shorter than in the gorilla. There is also some difference in the form of the nose; it is on the whole flatter, the tip is less apparent, and the nostrils are not so widely opened nor so thickly padded. The external ear of the chimpanzee has, on the whole, less resemblance to the human ear, and its contour is larger than that of the gorilla. But this organ varies so much in individuals that it is difficult to lay down any rule for its average size. The skin of the chimpanzee is frequently of a light yet muddy flesh-colour, which sometimes verges upon brown. Spots, varying in size and depth of colour, sometimes isolated, sometimes in groups, and of a blackish-brown, sooty, or bluish-black tint, are found on different parts of the body of many individuals, especially on the face, neck, breast, belly, arms and hands, thighs and shanks, and more rarely on the back. The face, which, soon after birth, is of a flesh-colour, merging into yellowish brown, assumes a darker shade with the gradual development of the body. The hairy coat is sleek, or only in rare cases slightly curled, and the coarser and bristly hair is generally stiff and elastic. The parting on the



TWO CHIMPANZES, "SUSAN" AND "JIMMY"
From a photograph by W. P. Dando

forehead is often so regular that it might have been arranged by the hairdresser's art. Close behind that part of the head at which the projecting ridges over the eyes of the gorilla generally meet there is in the chimpanzee [as is well shown in the figure on page 176] an altogether bald place, or often only a few scattered hairs. Round the face the growth of hair streams downwards like a beard. On the neck it is of considerable length, and it falls in the same long locks over the shoulders, back, and hips. The hair on the limbs is not so long and takes a downward direction on the upper arm, and an opposite direction on the forearm, while there is often a longitudinal parting on the centre of the inner surface of this part of the limb. On the back of the wrist the hair grows in a kind of whorl; the upper hairs turn upwards and backwards, the middle ones turn backwards, the lower ones backwards and downwards. The back of the hands and the roots of the fingers are hairy. On the front of the thigh the hair takes a downward direction, while behind it grows backwards. On the shank it grows downwards in the region of the tibia, and turns back on the inside of the leg. The back of the foot and the roots of the toes are likewise hairy. There is a shorter growth of these hairs on the face, chin, and ears. In other cases the hair of the true chimpanzee is of a black colour. Short whitish hairs may be observed on the lower part of the face and chin, as well as round the posteriors; and sometimes the colour of the hair is shot throughout with reddish or brownish black."

Hartmann's description applies to the typical chimpanzee (*Anthropithecus troglodytes*). As regards the local races of this species, the explorer Du Chaillu, in his "Equatorial Africa" (1861), described a chimpanzee known to the natives as nshiego mbouwe, and to naturalists as the bald chimpanzee (*A. troglodytes calvus*), and in the autumn of 1883 a young chimpanzee was purchased by the Zoological Society of London, which was recognised as being very different from the true or common chimpanzee, and was regarded as in all probability identical with Du Chaillu's bald chimpanzee.



YOUNG CHIMPANZEE AND ORANG-UTAN



THE CHIMPANZEE. "MAFUKA"

Writing of this animal, Mr. A. D. Bartlett remarked that, while "the colour of the face, hands, and feet in the true chimpanzee are white or pale flesh-colour, the same parts of the animal under consideration are black or brownish black. Another well-marked difference is to be found in the hair upon the head and face. In the true chimpanzee the hair on the top of the head and that passing down from the centre, where it divides, to the sides of the face or cheeks is tolerably long and full, forming what may be considered rather bushy whiskers; whereas in the new specimen the front, top, and sides of the head and face are nearly naked, having only a few short hairs on the head, quite destitute of any signs of the parting so very conspicuous in the chimpanzee. Another striking difference may be noticed in the size and form of the head and ears. Out of the number of chimpanzees I have seen and examined, both old and young, none has possessed the large flat ears that are so conspicuous in this individual. The form of the head, the expression of the face, the expanded nostrils, the thicker lips, especially the lower lip, together with the more elevated skull, cannot fail to distinguish this animal from the true chimpanzee. Again, the habits of this animal differ entirely from those of the common chimpanzee. She has always shown a disposition to live upon animal food. Soon after her arrival I found she would kill and eat small birds; seizing them by the neck, she would bite off the head and eat the bird, skin, feathers, and all; for some months she killed and ate a small pigeon every night. After a time we supplied her with cooked mutton and beef-tea; upon this food she has done well. I have never found any ordinary chimpanzee that would eat any kind of flesh.

"Another singular habit was the producing of pellets, or 'quids,' resembling the castings thrown up by birds of prey. They are composed of feathers and other indigestible substances that had been taken with her food. Moreover, she is an expert rat-catcher, and has caught and killed many rats that had entered her cage during the night. Her intelligence is far above that of the ordinary

chimpanzee. With but little trouble she can be taught to do many things that require the exercise of considerable thought and understanding; she recognises those who have made her acquaintance, and pays marked attention to men of colour, by uttering a loud cry of 'Bun, bun, bun.' She is never tired of romping and playing, and is generally in a good temper."

The bald chimpanzee is chiefly distinguished by the feature from which it takes its name. A second race, the kulu-kamba chimpanzee (*A. troglodytes kulu-kamba*), is characterised, on the other hand, by its marked approximation to the gorilla, both as regards its large size and the prominent ridges above the eyes. To this race belonged "Mafuka," a female formerly living in the Zoological Gardens at Dresden, which is figured on this page; and also the female named "Johanna," which was, for a time, one of the features of Messrs. Barnum and Bailey's show. This race has also been described under the name of *Troglodytes aubryi*, but its proper title is that given here.

As already mentioned, chimpanzees inhabit Western and Central Equatorial Africa, where they range over a considerable area of country. On the west coast their range appears to be limited to the north approximately by the River Gambia, while their southward range extends about to the River Coanza, which flows into the ocean at the boundary between Angola and Benguela. Their limits on each side of the Equator do not, therefore, exceed some twelve degrees, the northern range in latitude being greater than the southern. With regard to the extent of their range across the continent eastwards, chimpanzees occur to the north-west of the great lakes in the Niam Niam district, in 28° E., and they are also recorded from Monbottu, and range to about 32° E. in Uganda and Unyoro, the districts lying between Lakes Victoria and Albert.

Like all other man-like apes, chimpanzees are forest-dwelling animals, although on the coast of



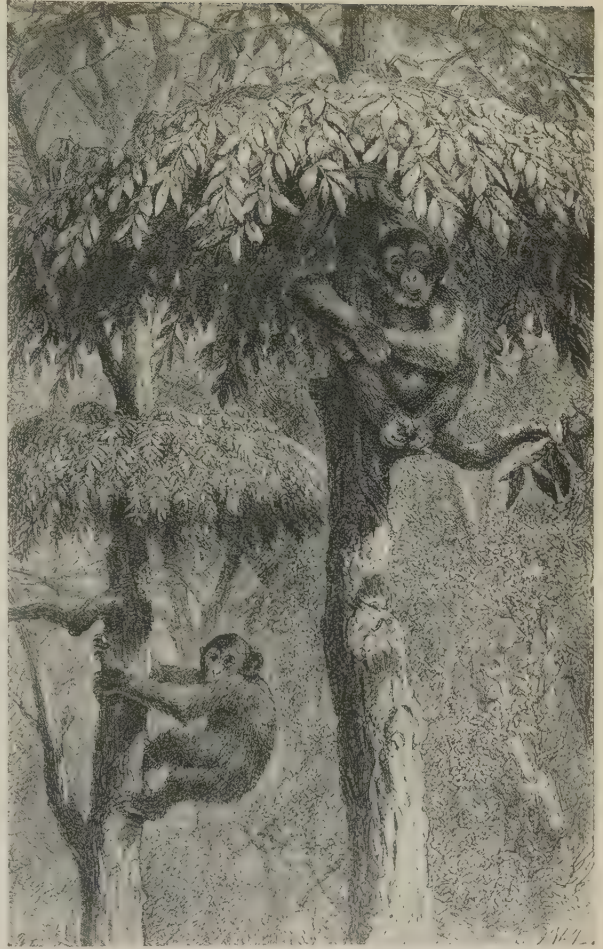
SIDE VIEW OF THE HEAD OF "MAFUKA"

the Loango district they are found in the mountains. Their food is usually the various wild fruits which grow abundantly in these dense woods; but, as already mentioned, at least the bald-headed species will take kindly to an animal diet in captivity.

Chimpanzees appear to be continually shifting their haunts in order to find fresh feeding-grounds, and will not unfrequently visit and pillage deserted native plantations. They utter loud cries, which may be heard resounding through the forests at all hours of day and night. Dr. E. Pechuel-Loesche, who accompanied the expedition sent to Western Equatorial Africa during the years from 1873 to 1875, observes that chimpanzees "are really accomplished in the art of bringing forth these unpleasant sounds, which may be heard at a great distance and are reproduced by the echoes. It is impossible to estimate the number of those who take part in the horrid noise, but we often seemed to hear more than a hundred. They generally remain upon the ground among the dense underwood and thickets of amomum [a member of the ginger family] and other scitamineous plants, and only climb trees for the sake of obtaining fruit. Their track may be plainly discerned on soft ground; they stop short wherever grows the amomum, of which they are very fond, and the red husks of the fruit of which may be seen strewn around."

There seems to be no doubt but that chimpanzees build a kind of nest high up in the trees for their families; and it is stated that the male of the family takes up his position for the night beneath the shelter afforded by the nest. It is probable that this habit has given rise to the idea that these animals construct pent-houses for themselves; an illustration of the bower is given in Du Chaillu's "Equatorial Africa." According to Du Chaillu, the creature ascends the trunk by a hand-over-hand movement and with great rapidity, creeps carefully under the shelter, seats itself on the base of a projecting bough, on which both feet and haunches rest, and then puts one arm about the trunk for security.

It is said that chimpanzees will generally take to flight at the sight of man, but that when driven to bay, or when their retreat is cut off, they will attack him fiercely, and are then very awkward customers to deal with. Dr. Livingstone, in his "Last Journals," gave an account and sketch of a chimpanzee hunt by the Manyema tribe, describing these animals under their name of soko, but apparently confusing them with the gorilla. The doctor's graphic sketch shows four chimpanzees surrounded by natives, one of the former having received its death-wound, a second with a spear in its back, and a fourth making a vigorous onslaught on one of the hunters, whose hand it has seized in its mouth. Dr. Livingstone states that the chimpanzee "kills the leopard occasionally, by seizing both paws and biting them, so as to disable them; he then goes up a tree, groans over his wounds, and sometimes recovers, while the leopard dies. The lion kills him at once, and sometimes tears his limbs off, but does not eat him. The soko eats no flesh; small



THE CHIMPANZEE'S NEST, OR SHELTER

From the drawing by J. Wolf in Du Chaillu's "Equatorial Africa"

bananas are his dainties, but not maize. His food consists of wild fruits, and of these one is large—a large sweep sop, but indifferent in taste. The soko brings forth at times twins."

In captivity, chimpanzees, when in health, are gentle, intelligent, and affectionate, readily learning to feed themselves with a spoon, or to drink out of a glass or cup. One of the earliest accounts of the captive chimpanzee was given by W. J. Broderip, and related to a young male brought from the Gambia in the year 1835, which was deposited in the gardens of the London Zoological Society. Dr. Hartmann has also published an interesting description of the habits of another male, which was exhibited in the Berlin Aquarium in 1876, and was remarkable for its unusually lively and cheerful disposition.

More recent is the description by G. J. Romanes of the mental power of the bald chimpanzee "Sally," which lived for eight years in London. This account was written in 1889, after the ape had been nearly six years in the Zoological Gardens. The intelligence of "Sally" is compared by Romanes to that of a child a few months before

emerging from the period of infancy, and is thus far higher than that of any other mammal, exclusive of man. In spite, however, of this relatively high degree of intelligence, the creature's power of making vocal replies to her keepers, or those with whom she was brought into contact, were of the



YOUNG CHIMPANZEE AT REST ON A BRANCH
Photograph by Lewis Medland

most limited kind. Such replies were, indeed, restricted to three peculiar grunting noises. One of these indicated assent or affirmation; another, of very similar intonation, denoted refusal or distrust; while the third, and totally different intonation, was used to express thanks or recognition of favours. In disposition "Sally" was, like many of her sex, apt to be capricious and uncertain; although, on the whole, she was good-humoured and fond of her keepers, with whom she was never tired of a kind of bantering play, which was kept up at intervals almost continuously. By singing in a peculiar kind of monotone, in imitation of her own utterance, her keepers were usually able to induce her to go through a series of remarkable actions, the meaning of which is not very apparent. First she would shoot out her lips into a tubular form, uttering at the same time a weird kind of howling note, interrupted at regular intervals. The pauses would, however, gradually become shorter and shorter, while the sing-song cry became louder and louder, until it finally culminated in a series of yells and screams, not unfrequently accompanied with a stamping of the feet and a violent shaking of the netting of her cage. After this climax the utterance of a few grunts ended the performance.

Some time before 1889 it occurred to Romanes that "Sally" would be a good subject to test the powers of the simian intelligence by a series of special experiments. It was found, however, that such experiments were seriously hampered by the effects on the creature of the visits of the numbers of people who were constantly passing in and out of the room in which she was kept; and there is consequently but little doubt that, in more favourable circumstances, the results obtained would have been more remarkable than they are.

Romanes, having secured the assistance of the keepers, caused them to ask "Sally" repeatedly for one, two, or three straws, which she was to pick up and hold out from among the litter strewn in her cage. The number of straws asked for was constantly varied, and never followed any regular order; and when the correct number was presented the animal was rewarded by a piece of fruit, while if the number were incorrect her offer was refused. "In this way," observes the author, "the ape was taught to associate these three numbers with their names. Lastly, if two or three straws were demanded, she was taught to hold one or two in her mouth until she had picked up the remaining straw, and then to hand the two or three straws together. This prevented any error arising from her interpretation of vocal tones. As soon as the animal understood what was required, and had learnt to associate these three numbers with their names, she never failed to give the number of straws asked for. Her education was then extended in a similar manner from three to four, and from four to five straws.

"Here I allowed her education to terminate. But more recently one of the keepers has endeavoured to advance her instruction as far as ten. The result, however, is what might have been anticipated. Although she very rarely makes any mistake in handing out one, two, three, four, or five straws, according to the number asked for, and although she is usually accurate in handing out as many as six or seven, when the numbers eight, nine, or ten are named, the result becomes more and more uncertain, so as to be suggestive of guesswork. It is evident, however, that she understands



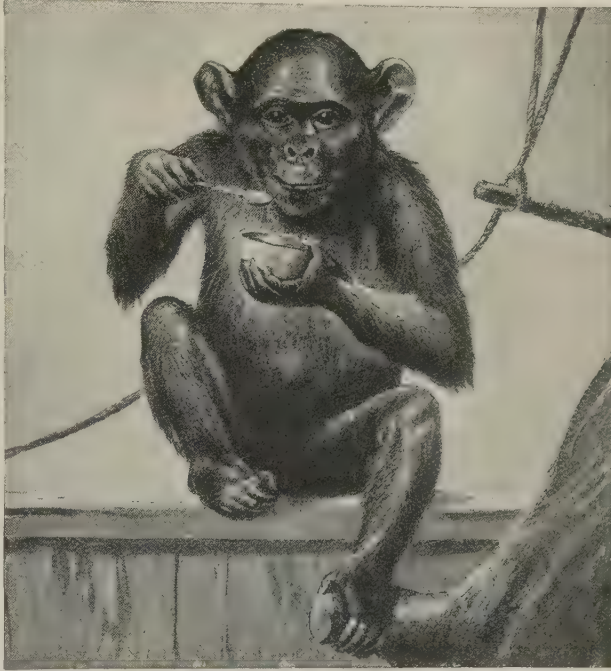
A CHIMPANZEE EVINCING INTEREST
Photograph by W. P. Dando

the words seven, eight, nine, and ten to betoken numbers higher than those below them; and if she is asked for any of these numbers, she gives some number that is above six and not more than ten; but there is no such constant accuracy displayed in handing out the exact number named as is the case

THE CHIMPANZEE

below six. On the whole, then, while there is no doubt that this animal can compute any number of straws up to five, beyond five the accuracy of her computation becomes progressively diminished."

In addition to these attempts to determine "Sally's" capacity for numbers, a series of experiments was undertaken to test her powers of recognising and distinguishing between colours. "It appeared to me," wrote Romanes, "that if I could once succeed in getting her to know the names of black, white, red, green, or blue, a possible basis might have been laid for further experiments wherein these five colours could have been used as signs of artificially associated ideas. The result, however, of attempting to teach her the names of colours was so uniformly negative that I am disposed to think the animal must be colour-blind. The method adopted in these experiments was to obtain a number of brightly and uniformly coloured pieces of straw, each piece being either black, white, red, green, or blue. Offered the straws two by two of different colours on each occasion, the ape was



THE CHIMPANZEE "SALLY"

invited to select the straw of the colour named from the one whose colour was not named, and, of course, on choosing correctly was rewarded with a piece of fruit. In this way she quickly learned to distinguish between the white straws and the straws of any other colour; but she never could be taught to go farther. Now, the distinction between the white straws and the straws of any other colour is a distinction which can be drawn by an eye that is colour-blind; and from the fact that the ape is always able to perceive this distinction, while she cannot be taught to distinguish any of the others, I conclude that her failure in this respect is not due to any want of intelligence, but to some deficiency in her powers of colour-perception."

A young chimpanzee, known as "Focke," lived for some time in the Royal Zoological Gardens at Dresden, where on several occasions he exhibited marked signs of more than average intelligence. On one occasion "Focke" was removed into the winter house, a large and spacious apartment with wooden benches fixed to the walls. Soon after his arrival he was seen to take up his position on one of these benches, where he remained for some time surveying his new abode. Next he examined all the utensils in the apartment, and more especially a jug of water. After some time he discovered a

knot-hole in a deal plank forming part of one of the benches, which seemed to puzzle him. He approached nearer to the hole, which he regarded attentively for some time. At first his object seemed to be to find to what depth it descended, and when he could not assure himself by other means of any limit in this direction he thrust his index finger as deep as it would go into the hole, and appeared to be astonished at finding no bottom.

He next seemed to be thinking the matter over for some time, after which he spat on the plank as near as possible to the hole, into which he afterwards guided the saliva with his finger. The fluid did not, however, suffice to fill the hole, the plank being laid a few inches above the uneven ground.

More puzzled than ever, the ape fetched the water-jug and poured its contents into the hole, when the water disappeared without filling the space between the plank and the ground. Thereupon "Focke," after returning the jug to its place, approached once more to the plank, near which he sat down in a thoughtful mood, from time to time

casting glances at the hole. On the following day he paid several visits to the spot, and made other attempts to ascertain the depth of the hole, but without success. Ultimately he seemed to realise the fruitlessness of all his investigations, and gave the matter up as a bad job, taking no sort of notice of the hole.

R. LYDEKKER

STORIES OF THE CHIMPANZEE

"Sally," to whom reference has been made, was not the first, and will not be the last, tame chimpanzee to display intelligence of a high order. Among the seven chimpanzees which at the end of 1909 were housed at the London Zoological Gardens were one or two in whom uncannily human attributes appeared. "Mick," the largest of the chimpanzees in residence in the year of grace just named, had been a character of the gardens for the preceding twelve years, having been deposited there when two years old. Another chimpanzee had been in the gardens some half-dozen years. Under close observation and encouragement these two animals should have gone far towards showing to what extent the chimpanzee can be trained. Certainly the highest possibility has not yet been attained.

Two public performers, "Consul I." and "Consul II.,"

attracted attention in the early years of the twentieth century by tricks of a surprising character. They wore, with seeming satisfaction, clothes like those of a human being. They ate at table with knife, fork, and spoon, and observed the amenities with propriety (page 103). They showed sufficient knowledge of cause and effect to realise that by banging the keys of a pianoforte sound was produced, and apparently they enjoyed the result of their efforts. This was, however, to take them back to Nature, so to speak; for in its wild state the chimpanzee thumps its hollow tree and howls with ecstasy. Possibly the same love of noise may account for the energy with which these animals tapped away at their typewriters. Their education stopped short, of course, of any intelligent attempt to order the sequence of the letters produced.

In common with the tricks of all other animals which perform in public, the feats of the highly educated chimpanzees which form part of a public entertainment are to be regarded with some suspicion. It is difficult to determine where obedience to protracted drilling ends and individual volition begins. For this reason the testimony of passengers who watched "Consul II." on board the liner by which it was carried to New York in November of 1909 is interesting. The animal roller-skated (page 183) and rode a bicycle on deck with delight, even when the ship was experiencing rough seas. To cycle and to skate are two of its public tricks, but here there was no compulsion, and the ape considered the exercise good fun. Moreover, it exhibited pleasure in helping to swab the decks after it had watched the sailors at their work. Nor were some of the occupations of the lady passengers less attractive to it, for in imitating them in the art of hemming handkerchiefs it is said to have displayed no mean ability. An animal which masters the feat of poising itself upon a bicycle and upon a pair of roller skates possesses intelligence that should not be lightly overlooked by the student of animal psychology.

The pity is that the subject has not received more systematic study. The chimpanzee in private custody stands a far better chance of making a good return for attention to its training. The life of an ape that performs in public is inevitably short. It is taught to smoke and to drink alcohol, and to indulge in food ruinous to the constitution of an animal whose natural diet consists of fruit and vegetables. A modern rival of the

two "Consuls" was an American-trained chimpanzee, which rode a bicycle, carried a miniature hod of bricks up a ladder, and smoked pipe and cigar. The chimpanzee privately trained need not acquire the tobacco and, emphatically not, the drink habit, and will long outlive its fellow of the circus and the music-hall.

In its natural environment the chimpanzee undoubtedly displays a grim sort of humour. The love of fun is by no means limited to captive specimens. Dr. Livingstone has told us how one of his men, when hoeing, was stalked and caught from behind by a chimpanzee. The man howled with terror, whereupon the chimpanzee "giggled and grinned, and left him, as if it had been in play." No other interpretation than the latter is possible. The chimpanzee knows that it has the power grievously to injure a man, and it has sense enough to discriminate between the armed man and the

unarmed. The latter need fear nothing; but the man who carries a spear must expect attack. An adult chimpanzee will seize the spearman, and bite off his hand. Women, from whom experience has taught the chimpanzee no harm is to be feared, are in no danger from these animals, despite many sensational stories to the contrary. It is true that now and then a chimpanzee will snatch up a baby and carry it to the top of a tree; but the motive seems to be the same spirit of innocent mischief

which prompts a monkey to carry property up the rigging of a ship in order to enjoy the fun of seeing the sailor's perplexity and anger. The child abducted by the chimpanzee seems to suffer no harm. A bunch of bananas will tempt the offender to earth again, when it will release the child in order to take the fruit.

But it cannot be pretended that the nature of the chimpanzee is compounded solely of good humour; the beast has characteristics of an opposite description, as a striking experience narrated by Sir Harry Johnston suffices to demonstrate. "I remember travelling home from West Africa once," he wrote,

"with a celebrated chimpanzee of many accomplishments, which, until we reached Madeira, travelled as, and was treated like, a first-class passenger, behaving in his freedom with absolute decorum. When the vessel reached Madeira, a number of passengers came on board, amongst others being a very young baby. This was sometimes placed by its mother in a cradle on



YOUNG CHIMPANZEE RESTING



YOUNG CHIMPANZEE WAITING TO BE FED

THE CHIMPANZEE

the upper deck. One day while we were at lunch, the chimpanzee, which had become very jealous of the attention shown to this infant, disappeared. I followed it from the luncheon-table to see what it was going to do, and arrived just in time to prevent it from throwing the baby overboard. It had pulled the poor little child from its cradle, fortunately without hurt, and would certainly have hurled it into the sea if my arrival had not caused the guilty ape to drop the child on the deck and shamble away. After this it spent the rest of its journey caged, on deck." This well-authenticated story implies striking reasoning powers in the chimpanzee, but not more than those which characterise the dog which, jealous of a kitten, carries its tiny rival out of the house and drops it into a pond.

On the other hand, the chimpanzee is capable of actions which we should describe as heroic were they performed by men. An instance of the kind was that in which the chief figure was a chimpanzee which for nine years enjoyed a good deal of freedom in the French town of Grenoble, whither it had been brought by its captor, an explorer. The ape was allowed to roam the town with the liberty which is claimed by the monkeys of Benares. Thus, when a child fell down a well, the ape was at hand to see the accident, and to effect a rescue. Swinging itself over the top of the well, it lowered itself quickly, hand under hand, down the rope by which the buckets were wound up and down, drew the child from the water, and carried it up in safety. This was the act of an untrained ape, yet in it instinct may be traced. The chimpanzee is heroic in defence of its own young. To rescue one of its kind from peril would be the work of an instant. A like instinctive desire would be called forth by the sight of a child that had fallen down a well. Is it too much to urge that we should accord to the chimpanzee as compassionate a nature as to the dog which plunges into a torrent to save the life of a drowning man?

The chimpanzee, untrained, has a ready perception of human sympathy. Livingstone had a young chimpanzee which he found a most affectionate companion. Secured near his tent, it was content so long as he remained in sight. It would squat on a mat at his feet, happy. If he went for a walk, his pet must go, too. She would manifest the greatest anxiety to be taken, holding out her hands to him; and, if disappointed by his going alone, she whimpered and wrung her hands with every evidence of grief. She was cleanly in her habits, and was careful to wipe her hands with leaves if they became soiled. If danger, real or imaginary, threatened, she retreated at once to Livingstone, and, standing upright against his legs, derived moral as well as physical support

to carry her through the trials and troubles that beset her.

Left to its own resources in captivity, the chimpanzee would probably develop but little intelligence. Its mental expansion appears to require external aid. One new idea will suggest others; the difficulty lies in impressing the first idea upon the ape's mind. Taught, after some trouble, the use of a key, a chimpanzee at the Manchester Zoological Gardens turned the knowledge to account by securing its own liberty. Another, which was placed in a cage within a cage to keep it from actual contact with the public, was wont to receive surreptitious gifts of nuts. These often fell beyond the ape's reach, but it discovered a way of securing them by flinging its blanket over them and suddenly withdrawing it. The same ape was shown how to use a stick for the same purpose. From this it learned that where a nut was still too distant to be touched by a short stick, the latter could be employed to reach a longer

stick by which the nuts could be gained. But although it became expert with these, it could never be taught to appreciate the use of the crooked handle for the task.

For another example of the curious limitations of the chimpanzee's intelligence we are indebted to Frank Buckland, who has recorded his experiences with one of the apes at the Zoological Gardens in the days when Mr. A. D. Bartlett was superintendent. The fine ape-house in which the man-like apes are now lodged was not in existence then, so, in order to give "Joe," the chimpanzee, exercise, it was the custom to let him have the run of the monkey-house before the public were admitted. Everything went well until the hour for the ape's return to his cage. Then he would hide on the top of the cages out

of the reach of his keeper, and no amount of coaxing would entice him down.

Bartlett discovered that "Joe's" weak points were curiosity and cowardice, and worked upon them with excellent results. He went to the keeper, and, touching him gently on the shoulder, pointed in a mysterious manner to the dark passage underneath the gas-pipe which traversed the house, affecting to believe that some nameless horror lurked there. The two men would peer at the spot with looks of dire alarm, and the effect upon "Joe" was electrical. If his two best friends were frightened, then there must be good reason for dismay. He would slowly descend to the floor, and, uttering his alarm note, steal towards the point of danger. When he had reached the right position, the two onlookers raised cries of simulated terror, and fled as from some object which, they pretended, was emerging from the darkness towards the room occupied by the ape. The ape, not to be behindhand in flight, cried



"CONSUL II." ON ROLLER SKATES

his loudest, and, his hair erect and bristling, bolted towards the open door of his cage, jumping, leap-frog fashion, over their heads in his anxiety to be first to reach it. The door was then promptly closed behind him, and he was safe.

This performance was repeated again and again. There was always the same difficulty about getting the ape back, but the trick never failed. His cowardice and curiosity were always successfully appealed to, for experience taught him as much as it taught the Bourbons.

ERNEST A. BRYANT

THE GORILLA

We have seen (page 176) that in 1590 an English sailor, Andrew Battel, had heard of a gigantic ape haunting the forests of Guinea, and known to the natives as the Pongo, this ape being also called by such names as Jina, N'Jina, or Indjina, or N'Guyala, while by Europeans it is universally termed the Gorilla. Buffon appears to have lent credence to Battel's pongo (N'Pungu or M'Pungu, as it is variously spelt); but his account was summarily rejected by Cuvier as a mere traveller's tale. Still, however, vague rumours of the existence on the West Coast of Africa of an ape of larger size and fiercer habits than the chimpanzee from time to time reached Europe; and in 1819 T. E. Bowdich, in his account of the "Mission from Cape Coast Castle to Ashanti," definitely stated that among the many curious apes found in the Gabun district, the ingenu (gorilla) was by far the largest and strongest. But it was not until 1847 that precise evidence of the existence of this mysterious ape reached Europe. In that year Dr. Savage, an English missionary stationed at the Gabun, wrote to the illustrious anatomist Sir Richard Owen enclosing drawings of the skull of an ape from that district, which was described as being much larger than the chimpanzee, and feared by the negroes more than the lion or any other wild beast of the forest. These sketches showed the bold bony crests over the eye-sockets which mark the skull of the gorilla as distinct from that of the typical chimpanzee. "At a later date in the same year," writes Sir Richard Owen, "were transmitted to me from Bristol two skulls of the same large species of chimpanzee as that notified in Dr. Savage's letter; they were obtained from the same locality in Africa, and brought clearly to light evidence of the existence in Africa of a second larger and more powerful ape." In the following year these specimens were described by the English anatomist under the name of *Troglodytes savageri*.

It appears, however, that about the same time that Dr. Savage forwarded the sketches to Sir Richard Owen he also sent a skull of the unknown ape, together with a description of the animal itself, by the hand of a fellow-missionary, the Rev. Dr. J. Leighton Wilson, to Boston, in the United States, and in an American scientific journal for the year 1847 the new ape was described and named *Troglodytes gorilla*. Thus matters stood till the year 1851, when Captain Harris presented to the Royal College of Surgeons the first skeleton of a gorilla that had

ever been brought to England; while in the same year another skeleton was sent to Philadelphia by Mr. H. A. Ford, a medical missionary. This made a distinct advance in our acquaintance with the creature; and in 1852 a French naturalist came to the conclusion that the gorilla ought not to be included in the same genus as the chimpanzee, and he accordingly proposed for it the name of *Gorilla gena*. By the rules of nomenclature adopted among zoologists, however, he had no right to supersede the specific name proposed in America; and the gorilla may thus be known scientifically as *Anthropopithecus gorilla* (see page 157).

In 1856 Paul Belloni Du Chaillu arrived at the Gabun, preparatory to his expedition into the interior, and two years later the British Museum received from the Gabun an entire gorilla preserved in spirits, the skin of which was soon afterwards mounted and exhibited to the public.

Such is the history of the gradual acquisition of our knowledge of the largest of the apes. On his return from the Gabun to America, Du Chaillu set to work to publish an account of his travels and adventures; and in 1861 the world was startled by the appearance of his "Explorations and Adventures in Equatorial Africa," which gave a full and illustrated narrative of numerous personal encounters with gorillas. Somewhat later, an Englishman, Winwood Reade, made an expedition to the Gabun for the purpose of verifying these accounts; the results of his journey being given in a work entitled "Savage Africa," of which the first edition appeared in 1863. In this work it is asserted that neither Du Chaillu nor any other European had up to that date ever seen a living wild gorilla in its native haunts, though Reade possibly did not refer to those driven to the shore in 1851 (page 186); and his assertions were supported by the members of the German Loango Expedition in 1873-76.

The features distinguishing the typical race of the chimpanzee from the gorilla have been referred to under the account of the former species (pages 176-7); but as these characters will not serve to distinguish the kulu-kamba chimpanzee from the gorilla, recourse must be had to other characteristics, of which the following, apart from anatomical points, appear to be the most important. In addition to its sullen, untamable, and ferocious disposition, the gorilla is distinguished from the chimpanzee by the greater length of the nasal, or nose, bones, which descend below the level of the lower border of the sockets of the eyes. It has also characteristic deep folds running from the angles of the nose to the corners of the upper lips. The great size of the canine and cheek teeth, especially the last of the latter, is also distinctive, as are the broad, short, and thick webbed hands and feet, the long heel, and the great relative length of the upper half of the arm and the proportionately shorter forearm. There are also differences in the form of the neck.

Having distinguished between the chimpanzee and gorilla, mention may now be made of certain

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characteristics by which these two species are collectively distinguished from the lower man-like apes, and thereby agree with man. One of these is that the total number of joints in the backbone, or vertebræ, lying between the solid mass called the sacrum and the neck is seventeen, or the same as in man. It is true, indeed, that whereas in man only twelve of these vertebræ carry ribs, in the gorilla and chimpanzee thirteen are so provided; but this is a matter of minor import, which is entirely over-balanced by the numerical similarity. The other point is the absence of the central bone in the wrist; so that whereas in man, the chimpanzee, and the gorilla the total number of separate wristbones is nine, in all the other Primates it is ten. This is a very important characteristic in connecting these two apes with man.

A full-grown male gorilla, if standing in a perfectly upright position, will generally measure rather more than six feet in height; and since his body is much more bulky and his limbs are longer than those of a man, he is decidedly the largest representative of the Primates. As in the chimpanzee, there are distinct eyebrows on the forehead and lashes to the lids of the eyes. The nose has a relatively long bridge, and its extremity is high, conical, and widely expanded, the whole length being divided by a distinct furrow running down the middle line and becoming more marked as age advances. The upper lip is remarkable for its shortness, and the whole of the dark skin in the region of the nose, cheeks, and mouth is marked by a number of folds. The massive jaws are extremely projecting, and with their huge tusks, or canine teeth, complete the repulsive aspect imparted to the expression by the overhanging eyebrows. The lower jaw has scarcely any indication of the prominent chin which is such a characteristic feature in the human countenance, but slopes rapidly away from the middle line in front, so as to assume a somewhat triangular contour. The whole skin of the face is a deep black colour, of a glossy appearance, and sparsely sprinkled with coarse hairs. The ears are comparatively small, with their hind border sharply angulated in the middle,

and appear to be fastened above and behind to the sides of the face. Like the face and lips, the ears are of deep black hue. The head is joined to the trunk by a very short and thick neck, which gives the appearance of its being set into the shoulders; and the term "bull-necked" is therefore strictly applicable to the creature. This great thickness and power of the neck is largely due to the backward projection of the occipital region of the skull, and the tall spines surmounting the vertebræ of the neck. In correlation with the great development of this region, we find the muscles of the shoulders and chest equally powerful, as is

essential for the movement of the mighty arms. On the latter the arrangement of the hair is the same as in the chimpanzee; but there is a great difference in the form of the hands, as may be seen from the illustration on page 174. Thus, in marked contrast to that of the chimpanzee, the hand is remarkable for its great width and stoutness, coupled with the shortness and generally clumsy make of the fingers, which are united together by a strong web reaching nearly to the end of their first joints. The thumb is short in proportion to the fingers, reaching only slightly beyond the middle of the metacarpal bone of the index finger, and is nearly conical in shape at its extremity. The fingers, on the contrary, are somewhat flattened at their extremities. There is but little difference, as seen in the figure, between the lengths of the index, middle, and ring fingers,

the first being in some specimens as long as, but in others shorter than, the middle finger. In all cases, however, the "little" finger is true to its name in being shorter than any of the others. The skin on the back of the wrist is thrown into a number of deep folds, with an oblique direction; while a network of wrinkles covers the backs of the fingers, which have large wart-like callosities on the first and sometimes also on the second joints, these callosities being produced by the animal walking, when on all-fours, with its fingers doubled on the palms of the hands. On the deep black and naked skin of the palms of the hands, which are hard and horny, there are generally numerous wart-like growths.



SKETCH OF A GORILLA AT REST IN A TREE

Apart from reference to its enormous bulk, especially in the lower part, no particular mention is necessary of the body of the gorilla, and attention may accordingly be directed to the hind limbs. One of the most important features in these is that the calves are more developed than in any of the other man-like apes. The foot, as contrasted with that of the chimpanzee in the illustration on page 174, is characterised by its great breadth and width, and also by the extreme shortness of the very thick toes. The big toe varies somewhat in length, as compared with that of the others, reaching in some individuals as far as the end of the first joint, and in others to the middle of the second. In contrast to the thumb, the great toe is expanded at the end, and, in opposition to the other toes, forms a grasping organ of remarkable power. None of the other toes is as thick as the big toe, the middle toe being slightly longer than either of the adjacent ones, while the "little" toe is considerably shorter. The sole of the foot is somewhat convex, but its upper surface is very flat, and there is no sort of resemblance to the human instep in the whole foot. The upper surface of the foot, as far as the beginning of the toes, is thickly covered with hair, but on the latter the hairs become thinly scattered; while the sole is bare and covered with a thick, horny skin. Owing to its habit of sometimes walking with the toes bent under the sole of the foot, the gorilla has callosities on the upper surface of the toes.

With regard to the colour of the hair, of which, as already noted, the general hue is blackish, there is considerable individual variation, and likewise a change attendant upon age, very old gorillas becoming more or less completely grizzled. As a rule, a reddish brown tint is noticeable on the hair at the top of the head, although it may be dark brown or even black, the hairs generally being differently coloured in different portions of their length. On the sides of the face the hair is greyish at the roots and dark at the tips; while on the neck and shoulders it tends to become lighter at the tips. A dark grey colour seems to characterise the tips of the hairs over the major portion of the body and the upper parts of the limbs; but below the tips these hairs have a dark brown ring, beneath which they again become lighter. On the lower parts of the limbs and hands the hairs are darker at their tips, where they vary from brown to black; but in some individuals these portions may be covered, like the trunk, with a mixture of grey and brown hairs.

The hair consists of an outer coat of long, stiff bristles, and of a shorter inner coat of fine, short, curly hairs, approximating to a woolly nature. The moderately long hair on the crown of the head is very stiff, and can be erected when the animal is enraged. Although the front and sides of the chin have but a short covering of hair, its upper portion has a distinct beard, or ruff. By far the longest hair on the upper part of the body is that growing on the shoulders, and hanging down thence on to the back and upper part of the arms. The length of this hair, however, is somewhat exceeded by that

growing on the thighs. On the chest and the rest of the under parts the hair is much shorter, that on the chest generally taking an upward and outward direction. The woolly under-hair is not very thick, and has no tendency to mat together. The long hair of the shoulders, back, and thighs communicates a shaggy appearance to the gorilla, although this is much less marked than in the orang-utan.

The female gorilla is much smaller than the male and, when standing upright, does not generally exceed about four and a half feet in height. The whole build is, moreover, relatively weaker, the tusks are but slightly developed, and the skull is proportionately smaller and more rounded, without the huge bony arches over the eyes. It appears, further, that in the adult female the bridge of the nose is shorter than in the male, while the cheeks are wider and the upper lip longer than is usually the case in the latter. The appearance of the female is therefore less ferocious and less repulsive than that of her lord and master.

The geographical range of the gorilla is much more restricted than is that of the chimpanzee, being limited to that district of Western Equatorial Africa lying between 2° N. and 5° S., and apparently not extending farther into the interior than 16° E. This hot and miasmatic region includes the mouths of the rivers Ogavai, Gabun, and Muni, and also the range of mountains running for about a hundred miles in a northerly direction between the Ogavai and the Cameroons, known as the Sierra do Cristal. According to Mr. H. A. Ford, gorillas are most common in the Sierra do Cristal, and have also been found a day's journey from the mouth of the Muni. During 1851 and 1852 numbers of gorillas, probably driven from the interior by want of food, were seen on the coast of the Gabun district, several of which were killed, the specimens sent by Captain Harris to London and by Mr. Ford to Philadelphia being probably some of these. Since 1852 they appear never to have been seen on the coast. According to the report of the German Loango Expedition, gorillas are very rare in the Loango district near the coast, but are met with in or near the mountainous region farther inland.

In regard to the actual mode of life of the gorilla there is a great dearth of authentic information. The old stories that these animals would seize with their foot natives passing beneath the trees on which they dwelt and drag them up, and likewise those to the effect that they gathered round the deserted camp fires of the natives, as well as the legends that they drove off the elephant with clubs, were disposed of once for all by Du Chaillu's account. The members of the German Loango Expedition frankly confess that they never saw a living wild gorilla, although they brought home a young one which had been captured by some native hunters; neither did Winwood Reade himself ever come across these creatures in their native wilds. A later German traveller, Herr von Koppenfels, appears, however, to have been more fortunate, and states that he once observed a male and female with their two young quietly feeding.

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From this account, and also from native report, it is known that gorillas habitually live in small families, having young ones of various ages with them; and that they frequent the most gloomy recesses of the forest, where the light of day is reduced to a twilight so dim that on cloudy days it might be supposed that the sun was eclipsed. The climate of these forests is hot and damp, suggestive of a Turkish bath or hothouse; and, as in most primeval forests, signs of animal life are extremely rare, although the stillness may be broken now and then by the voice of a bird. According

to the account given by Herr von Koppenfels — although this does not appear to be supported by others — gorillas are in the habit of making a kind of nest in the trees by bending the boughs together and covering them with twigs and moss at a height of several yards above the ground. In this nest the female and young pass the night, while the male takes his station at the bottom of the tree, where he remains in a sitting posture during the night, ready to protect his family against the attacks of prowling leopards. The same writer likewise states that gorillas do not frequent the same sleeping-place for more than three or four nights consecutively; and this is but natural when we reflect that they must wander to considerable distances in search of fresh supplies of food.

Contrary to the custom of most wild animals, other than monkeys, gorillas roam the forest in search of food solely during the daytime, and are totally stationary during the night. As a rule, they walk on all-fours; and while in walking the fingers of the hand are usually doubled on to the palm, the whole sole of the foot is applied to the ground. They can, however, walk with the fingers extended, and likewise with the toes bent down on the sole of the foot.

Although to all appearance male gorillas are somewhat unwieldy creatures, yet, like all their kindred, they are active and indefatigable climbers, and are said to ascend to the very tops of the forest trees,

where they pass from tree to tree almost as readily as the far lighter spider-monkeys of Brazil. They also seem capable of taking leaps from great heights to the ground without damage to themselves, since Herr von Koppenfels asserts that he even saw an adult spring from a tree at a height of some thirty or forty feet, and on alighting rapidly vanish into the jungle.

Although when driven to close quarters the gorilla is doubtless one of the most terrible of foes, yet it appears certain that very exaggerated accounts have been given of its natural ferocity. Herr von Koppenfels, as quoted by Dr. Hartmann, mentions

that so "long as the gorilla is unmolested he does not attack men; and, indeed, rather avoids the encounter." And when these creatures catch sight of men they generally rush off precipitately in the opposite direction through the underwood, giving vent at the same time to peculiar guttural cries.

Many gorillas are said to be killed by the natives with the aid of a weighted spear suspended in the creature's path by a cunningly devised system of cords. Others are, however, undoubtedly shot by the negroes, although it would seem that, at least in many instances, such animals have been accidentally met by the hunters as they travelled through the forest rather than deliberately sought out and tracked. As already mentioned, the members of the German Loango Expedition and Winwood Reade expressed their belief that

up to the dates of their explorations of the West Coast no European had ever seen a gorilla, but according to letters from Herr von Koppenfels, referred to by Dr. Hartmann, that traveller claimed to have killed several. In April, 1900, a gigantic gorilla, measuring 6 ft. 9 in. from the crown of the head to the tip of the middle toe, was shot near Tonsu, in the hinterland of the Cameroons, by Herr H. Paschen. This ape was marked down by a party of natives in thick bush. When approached by Herr Paschen and his party it rushed up a tall tree with marvellous speed, where it was shot by the German. Its skin and skull are preserved in the museum at Tring.



A FINE EXAMPLE OF THE FULL-GROWN MALE GORILLA
From a stuffed specimen in the Zoological Museum, Tring, Herts.

As we have already stated (page 186), the members of the German Loango Expedition received in 1875 a young male gorilla captured by native hunters. From the account of this animal given in the report of the expedition by Herr Falkenstein, it appears that, when first received at the station of Chinxoxo, in Loango, the hardships which it had undergone in its transit down country had reduced the creature to a deplorable condition. By the aid, however, of a plentiful supply of wild and other fruits, and the milk of a goat, the young animal was restored to something approaching its normal state of health; and preparations were then made for its transport to Berlin. Having been thus gradually accustomed to eat fruits and other food which could be procured on board ship, as well as to the company of Europeans, this young gorilla was finally shipped for Germany. During the voyage it was never chained up, and was soon allowed to wander freely about the ship with very slight supervision. This animal seems to have been of a gentle disposition and, although self-willed, was never malicious. In taking its food it was remarkably well-behaved, helping itself from a plate with its thumb and two fingers, and even carrying small vessels of water to its mouth, and replacing them undamaged when empty. When larger vessels of liquid were put before it, it would lower its mouth to them and drink by suction. Its regard for personal cleanliness was also noteworthy; and, when foreign substances adhered to its skin, it either brushed them off or held out its arms in a manner clearly indicating that it wished to have them removed.

When not able to obtain any article it desired, or when otherwise thwarted in its wishes, the youngster had recourse to various clever devices by which its object might be attained. For instance, "when he felt a desire for the sugar or fruit, which was kept in a cupboard in the eating-room, he would suddenly leave off playing and go in an opposite direction to the room, only altering his course when he believed that he was no longer observed. He then went straight to the room and cupboard, opened it, and made a quick and dexterous snatch at the sugar-box or fruit-basket, sometimes closing the cupboard door behind him before beginning to enjoy his plunder, or, if discovered, he would escape with it; and his whole behaviour made it clear that he was conscious of transgressing into forbidden paths. He took a special and what might be called a childish pleasure in making a

noise by beating on hollow articles, and seldom missed an opportunity of drumming on casks, dishes, or tin trays, whenever he passed by them." Strange noises, more especially thunder, alarmed him much.

This gorilla arrived safely at Berlin, where it was for a considerable period an inmate of the aquarium. There it thrived at first, and was docile, though

inclined to be mischievous. Eventually, however, it succumbed to the malady which sooner or later carries off so many of the large man-like apes in a northern climate, dying of a rapid consumption in the autumn of 1877, after having lived for fifteen months in Berlin.

By the intervention of Pechuel-Loesche and Falkenstein, a second living gorilla was obtained from the Loango district, and safely transported to Berlin, where it arrived in the early part of 1883. The journey during the winter appears, however, to have left its mark on the constitution of this animal, and, after living for fourteen months in the Aquarium, it



BABY GORILLA AT THE "ZOO"
Photograph by W. P. Dando

died of the same disease as its predecessor, in the spring of 1884. Dr. Hartmann states that there was a third live gorilla at Berlin in the autumn of 1881, which died soon after its arrival. There have also been of late years a few young gorillas in the London Zoological Gardens, but none survived long.

Curiously enough, so long ago as the year 1860, a travelling showman in England actually had a veritable living gorilla in his exhibition, which he considered to be a chimpanzee, no one suspecting till after the creature's death the nature of the treasure he had possessed.

R. LYDEKKER

STORIES OF THE GORILLA

As we have seen, there has been not a little to unlearn concerning the gorilla. Travellers' tales invested the animal with terrors and wonders as fantastic as were attributed of old time to the basilisk. The supposed ferocity and the awe-inspiring hideousness of the creature caused the natives to worship it. The gorilla is worshipped to-day as it was worshipped when Savage secured the first gorilla skull. That skull had been mounted on a pole and was the local idol, as deeply revered as the bottles from which had been drawn the medicine with which a missionary had cured the natives whom he afterwards found prostrated before them. Du Chaillu was assured that the spirits of men inhabited gorillas. Millions of natives in India to-day believe the same thing of tigers; and millions of men in past ages have believed that their fellows were converted into wolves and other animals.

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Probably not a native of the parts in which the gorilla has its home doubts to-day that gorillas make prisoners of men, and carry women away captive. The vitality of such legends is amazing.

But the credulity of the natives is not greater than the credulity of their betters. A European official reported that certain Tibetan apes had been discovered which were skilled potters and makers of wine. A picturesque account from a French explorer told of caravans held up by Titanic gorillas in Algeria, where one beast was said to have been captured measuring 7 ft. 6 in. in height, with a width of 4 ft. across the shoulders, and a weight of 720 lb., which is equal to the weight of five men of 10 st. each.

Nor is the store of travellers' tales exhausted. It is the character of the steaming climate in which it has its home that makes it so difficult to gain intimate knowledge of the habits of the gorilla in its wild state. For all the new facts that come to light, Africa might be as remote from us as before the days of steam. In one respect it is as well that this should be so, for the big-game hunter would speedily cause gorillas to be classed with many other extinct animals. The remoteness of this great ape from human observation is less surprising when we recollect that not until a few years ago had we ever heard of the okapi; that not until 1909 had a Tibetan takin been seen in Europe; that it took half a century to convince naturalists that the Australian duckbill platypus lays eggs.

Cleared of its reputation for gratuitous ferocity, the gorilla stands acquitted also of the charge of exceptional dislike of children.

Herr Falkenstein's details of the life of a young gorilla in captivity suffice to show how quickly the young animal takes kindly to human beings. The following effective picture appeared in "The Times," describing an afternoon with a young gorilla in captivity: "I found the creature romping and rolling in full liberty about the private drawing-room, now looking out of the window with all becoming gravity and sedateness as though thoroughly interested in, but not disconcerted by, the busy multitude and novelty without; then bounding rapidly along on knuckles and feet to examine and poke fun at some new-

comer, and playfully mumbling at his calves, pulling his beard—a special delight—clinging to his arms, examining his hat, not at all to its improvement, or curiously inquisitive as to his umbrella, and so on with visitor after visitor. If he become over-excited by the fun, a gentle box on the ear will bring him to order like a child—like a child, only to

be on the romp again immediately. He points with his index finger, claps his hands, puts out his tongue, feeds on a mixed diet, decidedly prefers raw, roast meat to boiled, eats strawberries with delicate appreciativeness, is exquisitely clean and mannerly."

Another writer describes the gorilla at play with a little boy and dog, his favourite companions, turning head over heels, chasing his friends, shaking hands, swinging on a trapeze side by side with his boy friend, giving him claret and water in a wine-glass, and behaving with grave courtesy and child-like good nature and docility. This writer found him "as like a little negro boy in the face as a being not absolutely human can be."

Frank Buckland, however, who was worrying at the time over a misconstruction of the Darwinian theory, would not have the latter description. Seeing the gorilla at play with two children, he remarked: "When the two humans and the gorilla were sitting at play on the ground floor, I could not help seeing the amazing difference between the countenances of the gorilla and of the children; the one decidedly and purely monkey, the others decidedly human. I could not, in fact, help seeing what a vast line the Creator had drawn between a man and a monkey." Buckland bore testimony, though, to the gorilla's absence of ferocity while at play with the children. Finding the ape respectful, grave, and somewhat distant towards adults, he watched with the greater curiosity when the two young people entered to see the ape. "After a while they both began to play with 'Pongo' [the gorilla]. Gradually they fraternised, and began to play together after the manner of little children. Not being a child, I cannot enter into their funny sayings and doings about nothing at all. So these three, the little boy and girl and the gorilla, played together for half an hour after their own childish fashion, and I made the children experiment on him with ornaments, handkerchiefs, etc." So much for the legend that the gorilla, young or old, is specially fierce towards children.

The authorities of the London Zoological Gardens have never had an opportunity of experimenting to any extent with their gorillas. The first arrived



BABY GORILLA AT PLAY
Photograph by W. P. Dando

at Regent's Park in 1887, and created a sensation in town. It was about three years old, and stood 2 ft. 6 in. in height. It arrived in miserable condition, and, refusing to leave its travelling cage, had to be forced into its permanent home. A young macaque monkey was assigned to it for company, but the ape was too indisposed to

return its friendship. Skilful attention and a diet of bread, milk, and fruit kept it alive for two months, but then it died. In the meantime it had made friends with its keeper, and showed signs of considerable intelligence.

The second venture was made in March, 1896, when the largest gorilla ever imported alive into England was obtained. It was just acquiring its permanent teeth, but though for a time it thrived, it never showed much activity, and died within five months. Two young female gorillas were secured in 1904, but did not survive a month, dysentery being responsible for the death of both. Still persevering, the Society secured in the following year a female gorilla of tender age, which was known for a brief spell of fame as "Miss Crowther." She had to be forced from the case in which she had travelled, into the cage adjoining the chimpanzees. Her arrival caused the wildest excitement amongst the latter, who shrieked and shook their cage and danced with rare vivacity. The stranger gave much trouble to her keepers, seeming determined to starve, and while life remained in her she was transported to New York.

A sixth gorilla arrived in March, 1906. It was a young female, and was so weak and fragile that she was never exhibited in public, being kept in a cage in a secluded part of the Gardens, whence she would be carried in the arms of a solicitous keeper for daily airings in the sun. From the first her case was hopeless. Doctors skilled in infantile complaints attended her daily; her diet and medicine were the subject of anxious consultations among the learned of the medical profession. As a leading official of the Gardens remarked, the young gorilla could not have been more anxiously watched had she been a millionaire's daughter. Pneumonia caused her death, and, after all their experiences, the authorities reached the conclusion that it is almost an impossible task to attempt to rear a gorilla in their Gardens. It is now agreed that unless gorillas can be caught young and kept in captivity near their home for some time before being brought away, thus giving them a chance of becoming accustomed to hand-feeding and to confinement, we must take our gorillas on trust, and meet them only in works of natural history or in travellers' tales.

Seeing how protracted and angry was the discussion of Du Chaillu's gorilla data, it may be of interest to quote here an incident recorded by A. D. Bartlett, at that time superintendent of the Zoological Gardens. "At Du Chaillu's request," he writes, "I went to Mr. Murray's to see the skin [of the gorilla] unpacked, and conveyed it to my office for inspection. I called M. Du Chaillu's attention to the face of the animal, which, I told him, was

not in a perfect condition, having lost part of the epidermis. In reply, Du Chaillu assured me that it was quite perfect, remarking at the same time that the epidermis on the face was quite black, and that the face of the skin being black was a proof of its perfectness.

"I, however, then and there convinced him that the blackness of the face was due to its having been painted black. Finding that I had detected what had been done, he at once admitted that he did paint it at the time he exhibited it in New York.

"The question that arose in my mind upon making this discovery was, did M. Du Chaillu kill the gorilla, and skin and preserve it? If so, he must recollect that the epidermis [outer skin] came off. Supposing he did forget this, he must have been afterwards reminded of the fact when he had to paint the face to represent its natural condition. These

facts, to which I had a witness, led me to doubt the truthfulness of M. Du Chaillu's statement, and it occurred to me that he was not aware of the condition of the skin, and probably had not prepared it himself." The point is of no importance now, but it shows that Du Chaillu was himself to blame for much of the incredulity with which his statements were for a time received. E. A. B



HEAD OF A YOUNG ORANG-UTAN

THE ORANG-UTAN

Partly from the reddish hue of its hair, and partly from the conformation of its face and skull, as well as the much greater proportionate length of its arms, the orang-utan (page 158) of Borneo and Sumatra (*Simia satyrus*) is a very different-looking creature from the chimpanzee and the gorilla.

The name orang-utan is a Malay word, signifying "man-of-the-woods"; and the ape so designated was known to Linnæus at least as far back as 1766. It was not, however, till a considerably later date that it became fully known in Europe. It is true, indeed, that in 1780 Baron Wurmb, then the governor of the Dutch settlement of Batavia, transmitted to Holland the entire skeleton of an orang-utan; but he did not recognise it as such, calling the animal to which it belonged the pongo—a name which belongs to the gorilla (page 184). In the year 1804, however, an orang-utan was living in the menagerie that belonged to the Prince of Orange; and this example was in that year described and depicted by a naturalist named Vosmaer. Subsequently to this the identity of Wurmb's pongo with the orang-utan was fully demonstrated; and from that period our knowledge of the structure and habits of this ape has gradually increased. Among those who have especially contributed to advance

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our knowledge of the orang-utan in its living condition we may mention Raja Sir James Brooke, of Sarawak, and Dr. Alfred Russel Wallace, the latter of whom has given an admirable account of the creature's habits, in his work, the "Malay Archipelago."

In the uncongenial climate of Europe, orang-utans are as difficult to keep for any lengthened period in confinement as are the large man-like apes of Western Africa. The case is, however, very different in the moist subtropical climate of Calcutta, where adults have thriven well in cages exposed to the open air, and have taught us many facts in relation to their habits. I once received from a friend in Singapore a photograph of an orang-utan remarkable for its coat of long hair; and the receipt of this set me wondering why a tropical animal like an orang-utan required such a profusion of hair. The only analogous instance that occurred

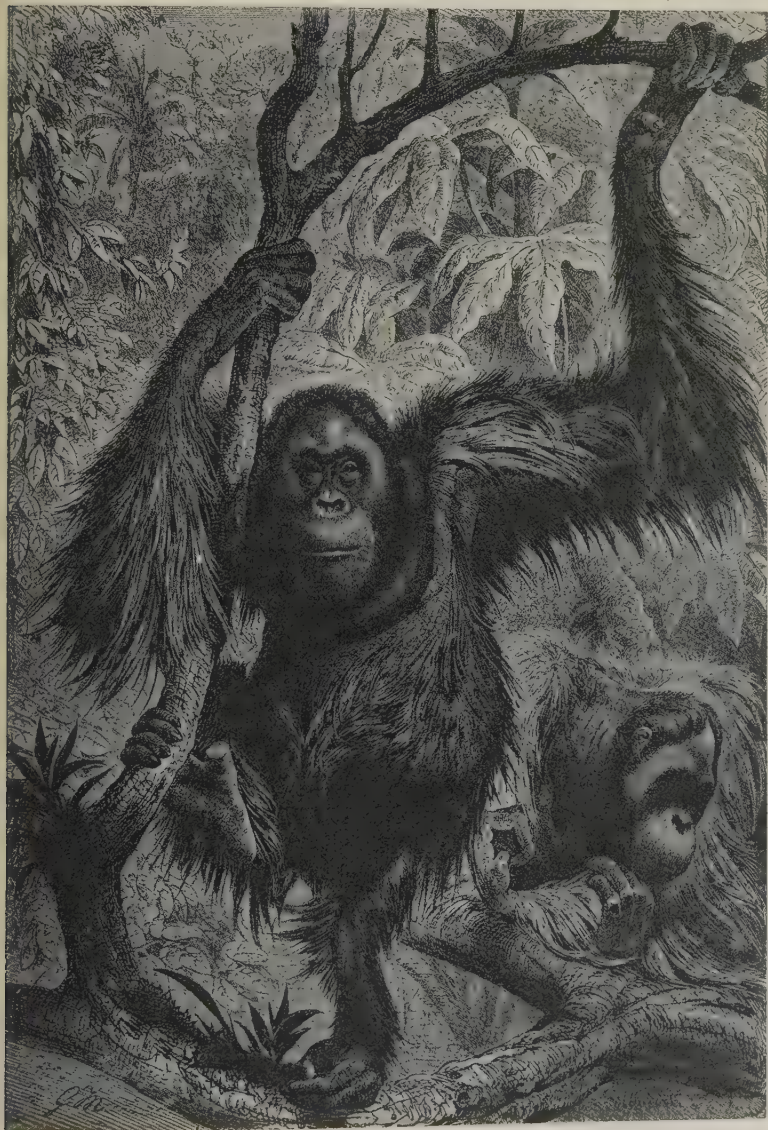
to me was the Indian sloth-bear, but the length and thickness of the hair were much less than in this orang-utan. Two suggestions arose with regard to the reason of the extraordinary capillary development in the latter species. The first was that it might serve as a protection against the deluges of rain in the wet season in the native home of the orang-utan, since these animals sleep in trees, where they must necessarily be much exposed, despite the protection afforded by the leaves and by the sleeping-place they construct for their abode. The second suggestion was that it must afford a protection against mosquitoes, which would presumably find some difficulty in reaching the skin through such a mass of shaggy hair.

The leading or, as naturalists say, generic characters distinguishing the orang-utan from the chimpanzee and gorilla are to be found in the proportionately greater length of the arms, which in the upright position reach to the ankles; and in the form of the skull, which is elevated almost into a point at the summit, as well as in a difference in the number of the joints in the backbone and of bones in the wrist. Thus there are sixteen (instead of seventeen) vertebrae in the backbone between the neck and the sacrum, twelve of these carrying ribs, as in man. In regard to the number of bones in the wrist, we find that the orang-utan possesses the central bone which is wanting in man, the chimpanzee, and the gorilla, and thus has nine, in place of eight, bones in the wrist. In this respect the Bornean ape agrees with the lower members of its order; but in the absence of callosities on the buttocks it shows its kinship with the gorilla and chimpanzee.

All these characteristic features clearly indicate that the orang-utan is decidedly lower in the scale than are the other two man-like apes.

An adult male orang-utan stands about 4 ft. 4 in. in height when in an upright position, in which posture it can almost touch the ground with its fingers. The legs are extremely short and thick, and twisted in such a remarkable manner that the knees are turned outwards, and the feet consequently set very obliquely to the line of the leg. From the peculiar structure of their legs and feet these apes walk entirely on the outer sides of their feet, of which the soles are turned inwards, so as almost to face one another. Although this arrangement is ill-adapted for walking rapidly on the ground, it is one admirably suited for climbing, in which these animals excel.

As shown in the illustration of the adult, the orang-utan has a tall,



ORANG-UTANS IN THEIR NATIVE FOREST

elevated forehead, very different from the retreating one of the chimpanzee; and the whole aspect of the face is curiously flattened, and often laterally expanded in old males, although there appears to be considerable individual or racial difference in this respect, some old males having comparatively narrow and rounded heads like the young. Not unfrequently there is a well-marked prominence in the middle of the forehead. Although there are slight ridges over the eyes, these are much less developed than in the chimpanzee, and have, therefore, no sort of resemblance to the enormous ones of the gorilla. The extraordinary height of the crown is well exhibited in the figure (see page 190) of the head of a young specimen, the whole of this part of the head being curiously shortened and compressed from back to front. In the immature animal the jaws are not very prominent, but they become much more projecting in old males. The bridge of the nose is much depressed and flattened, but the whole nose is generally larger than in the chimpanzee and gorilla, and not so much expanded at its termination, the wings being arched and narrow, and the small oval nostrils separated from one another by a narrow partition. The mobile lips are comparatively smooth and thin, the upper one being characterised by its great length and breadth. In the adult of the orang-utan, as shown in the illustration on page 191, the neck is surrounded by a kind of collar formed of folds of skin containing an internal cavity communicating with the larynx, or upper expansion of the windpipe. In some very old males these pouches attain enormous dimensions, and by no means add to the beauty of their owner. The ear is small and well formed, being much more human-like than that of the gorilla. Frequently the sides of the cheeks of the males have a warty protuberance, or callosity.

The body is not nearly so powerfully built as that of the gorilla is; and the sloping and stooping shoulders and extremely prominent abdomen make the whole shape of the animal ungainly in the extreme.

We have alluded to the great length of the very powerful arms, which vastly augment the animal's climbing powers. The hand (shown in figures 9 and 10 of the illustration on page 174) is even longer and more slender than that of the chimpanzee, and characterised by the remarkable shortness of the thumb, which scarcely reaches so far as the root of the first joint of the index finger. The fingers themselves are connected by a web, which extends for a third or nearly half of the length of their first joints. With regard to the relative lengths of the fingers, there is some amount of individual variation; but the middle finger may exceed either of the others, while the ring finger is longer than the index, and the "little" finger relatively long. All the fingers are narrow and tapering, with well-formed arching nails.

The calves of the legs are less developed than in either the chimpanzee or gorilla, and the narrow,

flat heels are less projecting. The long and slender feet (shown in figure 10 of the illustration on page 174) are likewise of a lower type of structure, as is particularly seen in the very small size of the great toe, which is peculiar among the Primates in frequently having no trace of a nail in the adult. Curiously enough, old animals often lose the last joint of the big toe, apparently not through disease, but as a normal condition. Both the hands and feet on the backs, and the hands on their under surfaces, have wart-like callosities.

The general colour of the orang-utan's skin is bluish grey, although it may have a more or less decided tinge of brown. In marked contrast to the general slaty hue of the face, there often occur yellowish-brown rings round the eyes, nostrils, and upper lip. The full reddish-brown hair is long, shaggy, and bristly, with a small admixture of woolly under-hair. The hair of the head may either have a natural parting in the middle, as in the figure of the head (page 190), or may be tossed in wild confusion, in some individuals standing almost upright. Usually there is a well-developed beard on the cheeks and neck. On the whole of the under surface of the body the covering of hair is thin and scanty, and it is even less developed on the face and ears, and the backs of the hands and feet.

The canines, or tusks, of the male are of enormous size. In the female, however, they are much smaller; and this sex is also characterised by the smaller development of the folds and pouches of skin around the neck.

As we have said, orang-utans appear to be confined to the islands of Borneo and Sumatra; and there has been considerable discussion as to whether there is more than one species. It was once thought that the large orang-utan of Sumatra was specifically distinct from that of Borneo, and it accordingly received a separate scientific name. But later investigations indicate that this is not the case, and that the animal is common to both islands, although individuals vary considerably in their colour. Probably the Bornean orang-utan is racially distinct from the one inhabiting Sumatra, and there may be local races in both islands. The Dyaks of Borneo, by whom the orang-utan is generally designated the *mias*, distinguish two forms, calling the one provided with cheek-excrecences *mias pappan*, and the one without these appendages *mias rambi*. In addition to these two varieties of the true large orang-utan, the Dyaks recognise a third kind, which they distinguish as the *mias kassir*. These animals are much smaller than the typical orang-utan, and never have the excrescences on the cheeks. A young individual of this orang-utan was described by Sir Richard Owen as *Simia morio*.

Orang-utans are stated to be much more numerous in Borneo than in Sumatra; and, since dense, low-lying forests are essential to their existence, they are not found in the neighbourhood of Sarawak, where the ground is hilly. The unbroken, large areas of primeval forests, occurring in many parts of Borneo, are the true home of the orang-utan;

THE ORANG-UTAN

such forests, according to Dr. Wallace, being like open ground to these apes, since they can travel in every direction from tree to tree, as easily as the North American Indian traverses his native prairie. In all their movements these apes are slow and deliberate, this being especially noticeable in the perfectly healthy adults which have been exhibited in the Zoological Gardens at Calcutta, where they enjoyed a climate not unlike their own. This deliberation in their movements is noticeable in Wallace's description of the manner in which these apes travel through the forest when undisturbed and at ease. We are told that they proceed with great circumspection along the larger branches of the trees, in the half-upright position rendered necessary by the great length of their arms and the shortness of their legs. Almost invariably they select such trees as have their branches interlaced with the adjacent ones; and, when such boughs are within reach, they catch hold of them with their arms as if to try their strength, after which they deliberately venture upon them. Although the orang-utan never leaps or jumps, and never seems to be in a hurry, yet he will make his way overhead in the forest as fast as a man can run on the ground below. In this progression the long, powerful arms are of the utmost service; and it is by their aid that these apes pluck the choicest fruit from boughs too light to support their weight, and likewise gather the leaves and young shoots to form their sleeping-places.

Orang-utans, like gorillas, go in small family parties, consisting of the parents, accompanied frequently by from two to four young ones. Although they will devour leaves, buds, and young shoots—more especially those of the bamboo—their chief food consists of fruits of various kinds, the prime favourite being the luscious but ill-smelling durian, or jack-fruit. Of this fruit they waste a vast quantity, throwing the rejected rinds on the ground.

The nest, or sleeping-place, of the orang-utan is generally constructed in a comparatively small tree

at a height of from 20 ft. to 50 ft. from the ground, at this elevation being protected from wind by the taller surrounding trees. The Dyaks believe that orang-utans construct a fresh nest every night; but, if this were the case, deserted nests would be much more common than they are. These apes remain in their nests till the sun has risen sufficiently high to have dried the dew from the forest leaves. Their feeding-time is during the middle of the day; but they seldom return for more than two consecutive days to the same tree for this purpose. It has been observed that the orang-utan must have a task of considerable difficulty in getting at the

interior of the durian, since the fruit is protected by a thick and tough skin, covered with strong conical prickles. Probably, however, the ape first bites off a few of these prickles or spines, and then makes a small hole, into which it inserts its fingers, and thus manages to pull the fruit in pieces.

An instance of the ferocious nature of the orang-utan when angered or driven to bay is given by Wallace in the following words: "A few miles down the river there is a Dyak house, and the inhabitants saw a large orang feeding on the young shoots of a palm by the river-side. On being alarmed he retreated towards the jungle, which was close by, and a number of men, armed with spears and choppers, ran out to intercept him. The man who was in front tried to run his spear through the animal's body, but

the mias seized it in his hands, and in an instant got hold of the man's arm, which he seized in his mouth, making his teeth meet in the flesh above the elbow, which he tore and lacerated in a dreadful manner. Had not the others been close behind, the man would have been more seriously injured, if not killed, as he was quite powerless; but they soon destroyed the creature with their spears and choppers. The man remained ill for some time, and never fully recovered the use of his arm."

The same writer relates the history of a young orang-utan which he received in Borneo when it was only a foot high. When first carried home, it



ORANG-UTAN IN THE HAGENBECK COLLECTION

tiny creature took such a firm grasp of its owner's beard that it was with difficulty it could be made to loose its hold. At the time of its capture there were no signs of teeth in its mouth, but in the course of a few days two of the lower incisors were cut. Unfortunately, there was at the time no means of obtaining a supply of milk for the little ape; but this difficulty was overcome by feeding it with rice-water sucked from a bottle with a quill through the cork. The animal soon managed to suck comfortably from this contrivance; and when sugar and cocoanut milk were added to the mixture it thrived well enough on the diet. If its owner introduced his finger into the ape's mouth, it first sucked vigorously, but soon found out its mistake, and pushed the finger away, with angry screams like those of a disappointed child. When caressed, it was contented and happy, but when laid down, soon began to scream; and for the first two nights of its captivity was very noisy and restless. It was kept in a kind of cradle, made of a box, with a soft mat at the bottom. The little orang-utan seemed to appreciate a frequent bath; and, indeed, when it required one, announced the fact by loud screams. The process of drying and rubbing after each bath seems to have been a source of great enjoyment; and this was likewise the case when its hair was combed and brushed. At first it clutched vigorously by all four limbs at any object in its neighbourhood, so that its owner had continually to be on his guard to save his beard. When it could find nothing better to do, it would nurse its own foot. Little by little the strength of the tiny creature's grip decreased, probably owing to the want of sufficient exercise. In order to remedy this, a short ladder was constructed, from which the ape was suspended by his hands and feet for a quarter of an hour at a time. This exercise seemed at first to afford it pleasure, but afterwards it loosened its hold, first with one limb, and then with another, till it finally fell to the ground. These tumbles did not appear, however, to do it much harm.

Its owner endeavoured to construct a kind of artificial mother out of buffalo-hide, which the baby orang-utan might fondle. For a time this afforded satisfaction, but eventually was discarded, as the animal was nearly choked with the hair it had torn off the skin, and swallowed. After a week's captivity it was fed from a spoon, containing a mixture of soaked biscuit, egg, and sugar, or, at other times, sweet potatoes. This food was swallowed readily, and with apparent satisfaction, the creature making droll grimaces to express either pleasure or the reverse. When it had swallowed anything which appeared grateful, it drew in its cheeks, and screwed

up its eyes; while, when the food was distasteful from want of sufficient sugar or other cause, the ape, after turning it about in its mouth for a short time, finally ejected it. If this rejected food were again offered, it displayed marked displeasure by loudly screaming and throwing its arms about.

After three weeks a young macaque monkey was introduced to the orang-utan, and the two, although very different in demeanour, soon became fast friends. The helplessness of the young orang-utan, when compared with the macaque, was especially noticeable; and this character distinguishes the young of all the man-like apes from those of the lower monkeys. Even after the young orang-utan had been about a month in captivity, it was very unsteady when placed on its hands and feet, and would frequently overbalance and topple over. When it required attention it would cry loudly for a time, but if this met with no reply the young creature would remain quiet till a step was heard approaching, when its calls would be at once renewed. Although at the end of four weeks the two upper incisors had been cut, the little creature, doubtless owing to improper food, had not increased perceptibly in weight, and soon afterwards sickened and died of a kind of intermittent fever.

Young orang-utans love play quite as much as children do, and appear to have several games of which they are specially fond. Ill-health, however, is apt to make them dull in European menageries.

R. LYDEKKER

STORIES OF THE ORANG-UTAN

Attention has been directed to the difficulty experienced in keeping the orang-utan in captivity. Possibly an extension of the principle of greater liberty for these animals may produce better results. That, at any rate, is the opinion of Carl Hagenbeck, the chief importer of wild beasts in Europe. His unique experience leads him to say: "It is not so much warmth that animals and birds require as fresh air. I have photographs showing my zebras and flamingoes, my lions and antelopes, standing out in deep snow, preferring it to the stuffy atmosphere of an enclosed den." The apes are notoriously less hardy of constitution than any of the animals named by Mr. Hagenbeck; but when all is said, we have the fact that there flourished in the London Zoological Gardens at the end of 1909 an orang which had been there fully five years; while the illustrious "Jenny" survived four years of the trying climate of the English metropolis.

The power of endurance in the orang-utan when



YOUNG ORANG-UTAN CLIMBING
Photograph by W. S. Berridge

THE ORANG-UTAN

wild seems to be exceptional, in so far as resistance to wounds is concerned. Dr. Wallace, in collecting specimens for museums, had to inflict severe injuries by means of gunshots before he could secure his prey. Some that had received several shots yet managed to escape. Even the young orang-utan which he succeeded in keeping alive for nearly three months survived a serious accident. When, after the death of the creature, he examined its skeleton, he found that it had suffered from a broken leg and a broken arm. These injuries were the result of a fall from a tree at the time of its capture. Yet the broken parts had united so rapidly that he had been unaware of the existence of the injury, and the orang-utan had regained comparative health upon an obviously inadequate diet.

The affectionate nature of this orang-utan is typical of the species. Fierce and vindictive if attacked, and fully conscious of the formidable power of its teeth, this ape in captivity is invariably gentle and docile, unless deliberately provoked to anger. Then it will unhesitatingly use its teeth. There are many instances of its curiously "human" characteristics. Mr. Frank Finn, who had considerable experience of the orang-utan in captivity at Calcutta, tells us that he found these apes less merry and less monkeyish than the chimpanzee, and more emotional and more exacting. "Disappointed, it will throw itself on the ground and roll about, crying like a spoilt child," as did Wallace's infant pet. Testimony to the orang-utan's preference for human company to that of the society of its kin is borne by an interesting experience which Mr. Finn had in the yard of a dealer. A cage in which a young orang-utan was confined was opened, giving the inmate freedom to choose its company. Disregarding all the monkeys in the yard, the ape sidled over to the dealer and quietly took its place in his lap. At the Calcutta "Zoo" was a female orang-utan which used to drop her food at the approach of Mr. Finn and affectionately put her arm round his neck. Another orang-utan of the same sex took a rooted dislike to a regular visitor because the latter had on one occasion given food to monkeys in the same house before visiting her.

"But," says Mr. Finn, in his interesting "Ornithological and Other Oddities," "it was, I think, on my very first introduction to the orang-utan that the hidden humanity of the creature first impressed me." This was when Mr. Abraham Bartlett, at the London Zoological Gardens, gave him a private interview with an orang-utan which had just arrived. "The first thing the little imp did was to climb on my knee, take off my hat, and put it on its own head,

after which it proceeded gravely to pinch one of the superintendent's eyelids. In short, it examined us with a scientific curiosity which, in a lower animal, was decidedly impressive. This little man of the woods could not have chosen a more striking way of claiming a kinship so often denied."

All who have seen the orang-utan in its native wilds agree that it is the most sluggish of the three great apes. Sir James Brooke, of Sarawak, had a poor opinion of the orang-utan's attempt to avoid human pursuers. "I never observed the slightest attempt at escape," he says, "and the wood which sometimes rattled about our ears was broken by their weight, and not thrown, as some people assert."

Against this, however, we have Dr. Wallace's evidence that on three occasions he saw female orang-utans, accompanied by their young, "breaking off branches and the great spiny fruit of the durian tree with every appearance of rage, causing such a shower of missiles as effectually kept us from approaching the tree." Sir James Brooke agrees with the common opinion as to the ferocity of the orang-utan when brought to bay: "One unfortunate man who, with a party, was trying to catch one alive lost two of his fingers, besides being severely bitten on the face, while the animal finally beat off his pursuers and escaped."

According to the same authority, when hunters wish to catch an adult they cut down a circle of trees round the one on which the orang-utan is seated, and then fell that also, and close in before he can recover himself, and endeavour to bind him. Sir James's experience goes some way towards justifying the stories which Wallace heard of many nests or arboreal huts made by the orang-utans. The former

was surprised at the facility with which they formed these structures. "I had an opportunity of seeing a wounded female weave the branches together, and seat herself in a minute." There she received the fire of her pursuers without moving, and expired in her lofty abode. An adult male which Brooke killed reclined lazily on a tree, and, when approached, only took the trouble to interpose the trunks between himself and the hunters, peeping out and watching, and dodging as they dodged. Sad to say, he left an arm exposed and,

being wounded in this limb, was incapacitated from flight, and was killed.

Happily, we are able now to study the orang-utan at close quarters without first seeing it suffer, for, despite the difficulties of catching and keeping it alive, specimens thrive in the Zoological Gardens, not only of London, but of Antwerp, Cologne, Frankfort-on-Main, Basle, and elsewhere. The



TWO BABY ORANG-UTANS AT THE LONDON "ZOO"
Photograph by W. S. Berridge

specimen at Basle had its liberty, and was wont to pass the hottest hours of the summer days in the pleasant shelter of a tall tree, without abusing the confidence of its keeper. The sluggish disposition of the ape may have contributed to the sense of safety with which its custodian liberated it, but it must not be inferred that the orang-utan has not intelligence enough to make its escape.

Darwin saw a young one put a stick into a crevice, slip its hand to the other end, and use the stick in the proper manner as a lever. He also records an orang-utan's manner of expressing fear of punishment. The little creature, expecting to be whipped for some fault, covered and protected itself with blanket or straw.

A newcomer to the London "Zoo" disarmed reproof by an even more diplomatic proceeding. Placed in the cage from

which one of the hapless gorillas had been removed, it at once began to tear away some of the wire netting. A keeper had to go in to put an end to the destruction. The orang-utan, expecting to be punished for its misdoing, flung its arms around the man's neck, and hugged him with such a show of affection that the stoniest of hearts would have yielded.

Another tame orang-utan, when unable to reach any article it desired, used to drag a chair from one end of the room to the other, and then stand upon it. By the same means it was enabled to reach a latch which the ape's natural height would not permit it to unfasten.

Sluggish the orang-utan may be, but not so sluggish as not to be alarmed at unfamiliar forms of life. Thus one showed the greatest fear on being confronted for the first time with a live turtle. Nor is the animal too sluggish to betray definite evidence of a sense of the ludicrous. Monkeys dislike ridicule; they hate to be laughed at; but the orang-utan which Darwin studied afforded instances to the contrary, of which he mentioned one: "Her feeding-tin was of a somewhat peculiar shape, and when it was empty she used sometimes to invert it upon her head. The tin then presented a comical resemblance to a bonnet, and as its wearer generally favoured the spectators with a broad grin at the time of putting it on, she never failed to raise a laugh from them. Her success in this respect was evidently attended with no small gratification on her part."

One orang-utan at the Zoological Gardens in London became known to fame under the name of "Jenny." She was, indeed, one of the most distinguished of favourites, and numbered a multitude of celebrities among her visitors. "Jenny" would take her cup of tea with the nicest skill, and, invested with a smart cap by Hunt, her faithful keeper, spoon or sip the beverage "in the most lady-

like way." Queen Victoria and other members of the Royal House paid a special visit to the Zoological Gardens to see "Jenny," who, however, was denied the use of her bonnet that day, the keeper fearing that her illustrious guests might deem her vulgar.

"Jenny" had a warm affection for her keeper, and was seen at her best when her house was not open to the public. Such occasion was a certain Christmas when Sir Richard Owen and his wife paid her a visit. Lady Owen thus describes the incident: "'Jenny' certainly attempts speech as far as her powers admit. When she is fond of a person she puts her long, strong arms round his neck, and makes a curious noise, like an attempt to utter caressing words, opening the lips and moving them as though

trying to make certain sounds. She produces a sort of murmur, which one might easily translate into kind expressions. To-day she took a fancy, when out of her cage, to look out of the window, and slyly crept along till she got there, under pretence of friendship. Hunt pretended to be offended at her not coming when he called, and she ran up to him, put her arms round his neck, whispering to him and kissing him, till he seemed to forgive her."

ERNEST A. BRYANT

THE GIBBONS AND FOSSIL APES

With the gibbons we come to the last of the man-like apes, distinguished from those which we have already described not only by their smaller size, lighter build, and longer arms, but also by the presence of small naked callosities on the buttocks, resembling those of the lower monkeys. They are, moreover, the only apes accustomed to walk in an upright position, in which, as shown in the illustration on page 197, they are at times assisted by their long arms, although they can walk perfectly well with their hands clasped behind the neck. On account of these differences, naturalists regard the gibbons as representing a family by themselves—the *Hylobatidæ*.

The gibbons, or long-armed apes, comprise several species found in the warmer regions of South-eastern Asia, and more especially in and around the Malay Peninsula. The largest of all the species only slightly exceeds three feet in height, while the others are not more than about thirty inches. Their arms are so long that they reach to the ankle, so that these apes can actually walk upright and at the same time touch the ground with their fingers. The head is well-shaped, without the upward prolongation of the crown that is so characteristic of the orang-utan; and the lower jaw is remarkable



AN ORANG-UTAN IN A TREE

Photograph by W. P. Dando

THE GIBBONS

for the great development of the chin, which is more human-like than that of any other ape. Moreover, from the absence of prominent ridges and crests, and the nearly upright forehead, the whole skull approaches the human type far more nearly than do the skulls of the other apes. This must not, however, be considered as an indication that the gibbons are of a higher type than the other man-like apes, since the contrary is clearly demonstrated by their long arms and the callosities on the buttocks. The resemblance of their skulls to the human type is, indeed, merely a superficial one, due to the circumstance that small animals necessarily have proportionately larger brains than the bigger members of the same group; and also to the absence of the strong ridges which are required for the powerful skulls of the larger forms, but would be quite useless in their smaller cousins. The superficial human-like characters of the skulls of the gibbons are, however, to a great extent masked by their long, slender tusks, or canines, which project far beyond the level of the other teeth. The long and narrow hands and feet of these animals (shown in figs. 11-13 of the illustration on page 174) are characterised by the extent to which the thumb and great toe are separated from the other fingers and toes, as well as by the flatness of all the nails. In colour, the gibbons vary from black to yellowish white, this variation occurring even in different individuals of the same species. The comparatively well-formed nose, as seen in the figure of the siamang (page 198), imparts to their physiognomy an expression far less repulsive and less forbidding than that which characterises the larger man-like apes.

Several of the gibbons are more or less black, among these being the Hainan species (*Hylobates hainanus*), which is often wholly so. Some years ago, however, a female example of this gibbon was deposited in the London Zoological Society's Gardens, obtained when believed to be about six months old. The ape was then dark smoky grey, which soon turned to black, and she remained black till after her arrival in London, when she was fully adult. A greyish tinge in the fur attracted attention in February, 1894, and by the following midsummer the lighter tint had so gained on the darker that no one would have recognised this ape as the one received in the previous January. In autumn she was silvery grey all over, except for a black band, fading on the sides and behind, down the middle line of the head; but later became brownish or silvery grey, varying in tint according to the light, the black band being retained, but as a narrowed

patch; while the hair on the chest turned pale and thin, showing the skin as a dark, triangular shield, that on the brows and the penultimate joints of the fingers and toes being black. This colour-change, however, does not appear to be characteristic of the species, for a jet-black gibbon in Hainan, said to be a male, had been in captivity long enough to justify the belief that it was about twelve years old; and it has been suggested that the change in the Zoological Society's specimen was the result of a process of decoloration or bleaching, and probably exhibited only by mature females.

Another remarkable colour-variation in this group has been recorded in Annam and Tongking by a French traveller, M. Louis Boutan, who, writing in the "Comptes Rendus" of the Paris Academy of Sciences, notes it in the case of the white-cheeked

gibbon (*Hylobates leucogenys*), a species originally described many years ago from Siam. These gibbons, according to M. Boutan, go about in small parties, comprising in most cases six or seven individuals, among which two types of very different appearance are frequently observable. In the first, or typical form, the otherwise black fur is relieved by well-marked white whiskers and a beard on the sides and lower part of the face. In the second form, on the other hand—which has been described as a distinct species, under the name of *H. henrici*, in honour of Prince Henri of Orléans—the general colour is golden yellow, and there are no white whiskers or beard. That the two are specifically identical is quite certain, and, according to our author, the light-coloured form does not pass into the black one as it grows older. The natives have, indeed, an idea that the pale



GIBBON, SHOWING LENGTH OF THE ARMS
 Photograph by W. P. Dando

gibbons are the females, but this M. Boutan denies; and it seems to be disproved by the fact that individuals of this colour are much less common than the black ones. Assuming these observations to be correct, we have here a clear case of the existence of what is known as dimorphism, or rather dichroism, in the gibbons of this species.

In disposition gibbons are gentle and confiding, and, when captured young, can be readily tamed. Their constitution is, however, even more delicate than that of the other man-like apes; and consumption soon terminates their existence in Europe, even when the greatest care and attention are bestowed upon them. In the Zoological Gardens at Calcutta they thrive excellently; and one kept there years ago was accustomed to make its presence known to people living more than a mile away by the loudness of its morning and evening cries.

All the gibbons are thoroughly arboreal in habit, and, in the rapidity of their movements among the trees, offer a marked contrast to the more deliberate and somewhat sluggish motions of the orang-utan. So rapid and lightning-like are these movements that one species—the hulock—has been observed, when in captivity at Calcutta, to catch birds on the wing that had flown into its cage; and there can be little doubt but that such habits are natural to these animals in their wild condition, when it is probable that birds thus captured constitute an appreciable portion of their food.

Although several of the species are found in the forests of the plains, the hulock appears to be almost, if not exclusively, restricted to those of the hilly districts. In marked contrast to the larger man-like apes, most gibbons go in large flocks or droves, which may comprise from fifty to a hundred, or even more individuals; although, as with most gregarious animals, solitary males are occasionally observed. The long arms are the chief agents in their active movements among the trees, and by

districts which they frequent is their custom of uttering at morn and even cries of a peculiarly loud and somewhat unearthly nature. These cries consist in the repetition of two syllables in quick succession; and the name hulock is given to the Indian representative of the group in imitation of its cry.

In all the gibbons the thumbs of both hands and feet are separated from the other digits to the base of the metacarpal and metatarsal bones, this character being found elsewhere among the Primates only in two genera of lemurs (*Indris* and *Propithecus*). The long-armed apes are true bipeds when on the ground, applying the sole flatly, with the big toe widely separated from the other digits; the hands are held up to be out of the way, rather than for balancing, even when ascending a flight of steps, but they are always ready to seize hold of any object to assist themselves along, just as a man grasps a banister when ascending a staircase.

THE SIAMANG

The siamang (*Hylobates syndactylus*) is the largest of the gibbons, and since it also differs in certain structural peculiarities, it may be dealt with first. This fine species is apparently confined to Sumatra, and its habits were described years ago by the French naturalist Duvaucel. When fully grown, this gibbon stands a little over three feet in height when in the upright position. It is of a uniform glossy black colour, with the exception of a grey or whitish beard, the hair on the body and limbs being comparatively long. The hair on the forearm is directed upwards towards the elbow, as in the larger man-like apes, whereas the other members of the genus have it pointing towards the wrist. There are two other features in which this species differs from the other gibbons; the first of these peculiarities, and the one from which the animal derives its scientific designation, being the circumstance that the second and third toes of the foot are joined together by a thin web of skin, reaching in the male as far as the last joint, but in the female only to the middle one. The second distinctive peculiarity of the siamang is the possession of a pouch formed by folds of skin round the neck and throat, resembling that mentioned as occurring in the orang-utan. The chin is also better developed than in the other gibbons.

Duvaucel says these apes assemble in troops in the forests, conducted by a chief, whom the Malays believe to be invulnerable, probably because he is more agile, more powerful, and more difficult to reach than the rest. Thus united, they salute the rising and setting sun with the most terrific cries, which may be heard several miles away and which, when near, deafen when they do not frighten. These apes are slow and heavy in gait; they lack confidence when they climb and agility when they leap, and can be easily caught when surprised. Nature, however, in depriving them of the means of readily escaping danger, has endowed them with a vigilance which rarely fails. If they hear a strange noise, even though they be a mile off, fear seizes them, and they immediately take flight. When surprised on the ground, they may be captured



A SIAMANG IN A SITTING POSTURE

Photograph by W. S. Berridge

their aid the distances they can swing from bough to bough, and thus from tree to tree, are surprising. When going downhill, they travel at an extremely rapid pace by swinging themselves in a downward direction from one bough to another on a lower level, from that to the next, and so on.

Although walking rapidly when on the ground, gibbons can easily be overtaken by men. When walking on the ground, the hulock rests on its hind feet alone, with the sole flat on the ground, and the big toe widely separated from the other digits. The arms are usually held upwards, sometimes horizontally, their great length (as shown in the illustration on page 197) giving the animal a peculiar aspect.

The fondness of the hulock for small birds has been mentioned, but, in addition to this kind of diet, gibbons subsist mainly on various fruits and leaves, as well as young and tender shoots; they also feed on insects and spiders and the eggs and callow nestlings of birds.

The habit which makes the gibbons known to, as well as cordially hated by, all who dwell in the

THE GIBBONS

without resistance, being either overwhelmed with fright, or conscious of their weakness and the impossibility of escaping. At first, indeed, they endeavour to avoid their pursuers by flight, and it is then that their awkwardness is most apparent. Their body, too tall and heavy for their short, slender thighs, inclines forwards, and, availing themselves of their long arms as crutches, they advance by jerks, which resemble the hobbling of a lame man whom fear compels to an extraordinary effort.

Their want of agility when surprised on the ground, however, is amply made up for when in the trees, where they take long flying leaps. According to a German writer, siamangs inhabit the forests in Sumatra at an elevation of 3,000 feet above the sea-level, rarely leaving the trees to descend to the earth. At any sudden fright they rush violently down the mountain-sides, by leaping from bough to bough and from tree to tree in the manner already described. Dr. Wallace maintains that the siamang is decidedly slower in its movements than the other gibbons, not taking such tremendously long leaps, and keeping at a lower elevation in the trees. The extraordinary relative length of its arms is indicated by the same writer, who observes that in one specimen about three feet in height, they measured 5 ft. 6 in. from hand to hand, when both arms were stretched out from the body. A young siamang that was brought to Wallace was at first somewhat savage, but soon became more amenable to discipline, feeding readily on rice and fruits. This individual did not, however, long survive in captivity; and it appears that the Malays, who are adepts in keeping and taming wild animals, find it exceedingly difficult to rear siamangs for any length of time. Siamangs have been exhibited alive in the Zoological Gardens at Calcutta. In disposition they are regarded by the Malays as stupid and dull. This species has been stated to occur in the Malay Peninsula, but this is disputed, and it appears to be but little known, even in Singapore, where the captive specimen mentioned above attracted a considerable amount of attention.

A white siamang is recorded from Sumatra.

THE WHITE-HANDED GIBBON

The first example of the more typical species of the group, all of which are very closely allied, is the white-handed gibbon (*Hylobates lar*). This species (page 159), like the other typical gibbons, is considerably smaller than the siamang, standing about thirty inches in height; and it is also of a lighter and more slender build. Although subject to great variation in colour, it may be recognised by the pale colour of the hands and feet, of which the upper surfaces are usually either white or yellowish white. Another distinctive characteristic is to be found in the presence round the black skin of the naked face of a complete ring of more or less nearly white hairs, which imparts a most peculiar aspect to the animal. Occasionally, however, this white ring is almost absent; different individuals showing a gradation in this respect, from those in which it is but very slightly developed to those in which it attains its full proportions. The general colour of

the body and limbs of this gibbon varies from a full black, through various fulvous shades, to a yellowish white. In opposition to what usually obtains in mammals, some individuals of this species have the back lighter than the under parts of the body; and it may occasionally be much variegated.

The white-handed gibbon is met with throughout the Malay Peninsula, as far north as the province of Tenasserim, and may possibly reach into Lower Pegu. It inhabits the forests skirting the mountains, at elevations varying from about three thousand to three thousand five hundred feet above the sea.

The white-handed gibbon is somewhat more heavily built and less agile than the hulock, and it walks on the ground less steadily. It is also said to differ from the hulock in its manner of drinking—scooping up water in its hands, and thus carrying it to its mouth, instead of applying its mouth directly to the surface of the water. There is a great difference in the voice of the two species. The white-handed gibbons are also stated to go about in smaller parties than the other species, the number in a drove being usually from six to twenty. They depend almost entirely on their hands in passing from bough to bough, and use their feet to carry food. A drove of these apes has been seen to escape in this manner with the plunder stolen from a garden made by a Karen tribe near the forests which they frequent. Like other species of the group, the white-handed gibbon almost



THE WHITE-HANDED GIBBON
Photograph by Lewis Medland

invariably has only a single young one at a time. The young are born at the beginning of the winter and cling to the body of the mother for nearly seven months, after which they shift for themselves.

THE HULOCK

One of the best known of all the gibbons is the hulock (*Hylobates hulock*), or white-browed gibbon, which takes its name from its characteristic two-syllabled cry. This is the only species which occurs in India, where it is confined to the north-eastern districts, being found in the hill ranges south of the Assam valley, as well as in the provinces of Sylhet, Cachar, and Manipur. Thence it ranges to the east

and southwards into the hill forests of the Irawadi valley near Bhamo, in Upper Burma, and in the neighbourhood of Chittagong and Arakan. It may also occur near Martaban, in Upper Tenasserim; but the extent of its range on the east side of the Irawadi river is not yet definitely determined.

The hulock may be readily distinguished from the white-handed gibbon by the presence of a white or grey band across the eyebrows, and also by the whole of the rest of the head, as well as the upper surfaces of the hands and feet, being of the same colour as the body. This general colour varies from black to a light yellowish grey, the females being usually paler than the males. Their build is rather lighter, while their habits are more active than those of the white-handed gibbon.

All who have written of the hulock agree as to its docile and engaging disposition, and the readiness with which, even when adult, it can be thoroughly tamed in a short space of time. Writing of a pet hulock formerly in his possession, Mr. R. A. Sterndale observes: "Nothing contented him so much as being allowed to sit by my side with his arm linked through mine, and he would resist any attempt I made to go away. He was extremely clean in his habits, which cannot be said of all the monkey tribe. Soon after he came to me I gave him a piece of blanket to sleep on in his box, but the next morning I found he had rolled it up and made a sort of pillow for his head, so a second piece was given him. He was destined for the Queen's Gardens at Delhi, but, unfortunately, on his way up he got a chill, and contracted a disease akin to consumption. During his illness he was most carefully attended by my brother, who had a bed made for him, and the doctor came daily to see the little patient, who gratefully acknowledged their attentions, but, to their disappointment, he died. The only objection to these monkeys as pets is the power they have of howling, or rather whooping, a piercing and somewhat hysterical 'whoop-poo! whoop-poo! whoop-poo!' for several minutes, till fairly exhausted."

Mention has been made of the wide distance over which the cries of a hulock kept in the Zoological Gardens at Calcutta could be heard. Dr. W. T. Blanford, writing of the cries of these animals, remarks that "at a distance the sound much resembles a human voice; it is a peculiar wailing note, audible from afar, and in the countries inhabited by these animals is one of the most familiar forest sounds. The calls begin at daybreak, and are continued until 9 or 10 a.m., several of the flock joining in the cry, like hounds giving tongue. After 9 or 10 o'clock in the morning the animals feed or rest, and remain silent throughout the middle of the day, but recommence calling towards evening, though to a less extent than in the earlier part of the day."

Like the white-handed gibbon, hulocks have been exhibited, although less numerous, in the Gardens of the Zoological Society in Regent's Park, London.

The Hainan gibbon (*H. hainanus*), the coloration

of which has already been discussed (page 197), is allied to the hulock, but differs from that and all other species, except the siamang, in the absence of a white band on the forehead, and is thus, when in the black dress, wholly sable.

THE AGILE GIBBON

The agile gibbon (*Hylobates agilis*) is subject to such an amount of individual variation that several so-called species, such as the Malay gibbon of Sumatra and the crowned gibbon of Siam, have been founded upon what appear to be nothing more than local races or varieties of one and the same species.

Inclusive of all these local varieties, the agile gibbon has a rather wide geographical distribution, ranging from Cochin China to Siam; it is also found in Sumatra and Borneo, as well as in the small islands of the Sulu Archipelago lying between Borneo and the Philippines.

The activity of the agile gibbon, which is known to the natives of Sumatra as ungka, or ungka-puti, is sufficiently attested by its name. It was this species which was first observed to have the power of catching birds while on the wing (page 198); and the animals are capable of taking clear leaps of forty feet when passing from bough to bough. They are stated to live in pairs rather than in droves.

In the typical form of the agile gibbon from Sumatra the general colour is usually dark brown, the face being bluish black or brown, and surrounded by whitish hair, through which the ears are only partially visible, while the hands and feet are of the same general colour as the body. It may be distinguished by the prominent arches on the skull above the eyes, the comparatively flat nose, and the large nostrils. The colour of the back in the darker varieties is lighter than that of the under parts. The variety named after Sir Stamford



THE HULOCK GIBBON
Photograph by W. S. Berridge

THE FOSSIL APES

Raffles (*H. a. rafflesi*) is nearly black, tending to brown on the sides and back. The Siamese variety, known as the crowned or tufted gibbon (*H. a. pileatus*), is likewise of a blackish colour, but differs in that the hands, feet, and a ring round the crown of the head are white. The white patch on the crown helps to distinguish this variety from the typical agile gibbon, although all these Malay gibbons are singularly alike, and often difficult to distinguish even by the practised zoologist. The so-called variegated gibbon (*H. a. variegatus*) appears to be merely another of the numerous phases of the agile gibbon.

THE SILVERY GIBBON

The grey or silvery gibbon (*Hylobates leuciscus*), or wou-wou—a name often incorrectly applied to the agile gibbon—comes from the island of Java, and most naturalists agree in regarding it as a distinct species. It is characterised by its general ashy or bluish grey colour; the presence of a large square black patch on the top of the head; and also by the white or grey fringe of hair surrounding the blackish face. The fur also appears to be longer, thicker, and of a more woolly nature than is the case in the other species; and the colour is stated to be usually lighter on the under parts than on the back. Specimens of this and the preceding species have been exhibited in the London Zoological Society's Gardens in Regent's Park.

FOSSIL APES

Allusion has already been incidentally made (page 156) to the fossil remains of the man-like creature known as *Pithecanthropus erectus*, which were discovered by Dr. Eugène Dubois in Java in 1891. These relics comprised a calvarium, or vaulted portion of the skull, two molar teeth, and a left femur, or thighbone. The first two fragments were found together, and the femur was brought to light about a year later at a distance of a few yards, and Dr. Dubois considered they all belonged to an animal that came between man and the anthropoid apes, and were of Pliocene or early Pleistocene age. Enthusiasts recognised in the remnants the long-looked-for "missing link," but more cautious observers doubted whether the cranium and femur belonged to the same skeleton, maintaining that the former was of a low human type, while the femur was human. The teeth are large and powerful.

It has always been a matter of surprise that no large man-like ape now inhabits the dense tropical forests of India or Burma, which would appear to be just as suitable for these animals as are those

of Borneo or Equatorial Africa. However, the discovery in the north-west of India, in rocks belonging to the Pliocene or later division of the Tertiary period, of a jaw of a large ape apparently belonging to the same genus as the chimpanzee shows that large man-like apes must have once roamed over the plains of Hindustan. Why

chimpanzees, together with hippopotamuses and giraffes, which are likewise found fossil in India but are now confined to Africa, should have totally disappeared from the former country is one of those puzzling problems connected with the distribution of animals which there is little hope of answering satisfactorily. The fossil chimpanzee was found in the arid districts of the Punjab, and since we know that the living man-like apes dwell in the deepest gloom and solitude of primeval forests, where vegetation grows luxuriantly and offers a constant supply of fruits throughout the year, it may be inferred that the Indian chimpanzee inhabited a similar forest-clad country; and that, consequently, the present area of the Punjab was, in parts at all events, clothed with forests in which dwelt this ape, instead of being, as now, a sun-scorched and somewhat desolate region.



THE HAINAN GIBBON
Photograph by Lewis Medland

Evidence of the former existence of these forests is afforded by the occurrence of numbers of fossil tree-stems in various parts of the same series of rocks from which the remains of the fossil chimpanzee were obtained.

Curiously enough, the same strata have also yielded the broken tusk, or canine tooth, of another large ape, which there is every reason to believe was a species of orang-utan. If this be so, it is possible that India may have been the original home of the ancestors of all the large man-like apes of the present day, and that from this centre their descendants have gradually dispersed eastwards and south-westwards. At a still earlier date, however, Africa would appear to have been the home of the group, as the lower jaw of a small man-like ape from the Oligocene strata of the Fayum district in Egypt has been described as *Propliopithecus*, and regarded as representing the ancestor of both the man-like apes and man himself.

In addition to the fossil Indian apes, we have, moreover, sure evidence that at an earlier part of the Tertiary period, known as the Miocene age, one or more species of large man-like apes inhabited Western Europe. One of these extinct creatures has been named *Dryopithecus*, and its remains have been found in Miocene strata in France, in

which beds have also been discovered relics of another genus, to which has been given the name of *Pliopithecus* ("Ancient Ape"), which is supposed to exhibit characters approximating more or less closely to the gibbons. It appears to have been about the same size as the chimpanzee, but differs from all the living man-like apes in the great length of the bony union between the two branches of the lower jaw. In this respect this ape approaches decidedly towards the lower monkeys.

In explorations conducted in the caves of Borneo, remains of gibbons, probably belonging to species still in the same regions, have been met with in a sub-fossil condition. This is only what we should naturally have expected to be the case. Very different, however, is the occurrence of fossil gibbons in freshwater strata belonging to the middle portion of the Tertiary period in France and Switzerland; for it is certain that these animals could not have lived in a climate at all approaching that which now distinguishes Europe. We shall therefore be safe in assuming that, at the epoch in question, portions of Southern Europe were clothed with dense forests, growing in a hot and moist climate closely resembling that of the Malay Archipelago of the present day. The evidence for the former prevalence of this tropical European climate does not, however, rest solely on the fossil gibbons, since many of the other animals found in the same strata are very similar to those now characteristic of the warmer regions of the East; while the presence of palms resembling those of tropical lands, as well as other plants, supplements the evidence of the animal remains in a convincing manner. After the Middle or Miocene division of the Tertiary period there is no evidence of the existence of gibbons in any part of Europe, although many kinds of monkeys were abundant until much later. R. LYDEKKER

STORIES OF THE GIBBONS

Admitting that the gibbon can bite at need, the weight of evidence in favour of its amiable and affectionate nature is overwhelming. Dr. H. O. Forbes, the well-known naturalist and explorer, in his "Handbook to the Primates," gives a very attractive picture of a young siamang which he kept in Sumatra: "The gentle and caressing way in which it clasps me round the neck with its long arms, laying its head on my chest, and watching my face with its dark brown eyes, uttering a satisfied crooning sound, is most engaging." This gibbon became as much a pet as was Livingstone's young chimpanzee, and demanded as full a return of friendship. Nor was it denied, for Dr. Forbes writes: "Every evening it makes with me a tour round the village square, with one of its hands on my arm. It is a very curious and ludicrous sight to see it in the erect attitude on its somewhat bandy legs, hurrying along in the most frantic haste, as if to keep its head from outrunning its feet, with its long, free arm see-sawing in the most odd way over its head to balance itself, and now and again touching the ground with its finger-tips or its knuckles."

In Calcutta the experiment was tried of allowing complete freedom to one of the hullocks, and the plan was for some time quite successful. Mr. Frank Finn, in the work to which reference was made on page 195, likens this gibbon, as he runs along the ground, to a little man in a fur coat. Food was daily put out for the gibbon, but he provided to a considerable extent for himself. He had sufficient confidence in mankind to pay frequent visits to the refreshment bars to be fed by sightseers. He got



THE AGILE GIBBON
Photograph by W. S. Beridge

his drink in quite a natural way, by sliding down a bough overhanging a pond and dipping up the water with his hand. His round was not confined to the grounds of the Zoological Gardens in Calcutta, but, by means of the telegraph wires, he would accomplish journeys to more or less distant parts of the city. In one of these rambles he turned up at the abode of the lieutenant-governor and hauled down the British flag. For this act of disloyalty and treason his liberty was for some time sacrificed, but eventually he was free once more to wander. In the end he turned savage over a love affair, like many a wiser and many a more foolish creature than himself. There were two female gibbons in one of the monkey-houses, and to these the hullock used to pay visits, and exchange confidences through the bars of the respective cages. "I do not know if the worry of this double ménage affected his temper," says Mr. Finn, "but ultimately he became vicious, and had to be shut up permanently."

We have not the opportunity of seeing the gibbons free in the London Zoological Gardens, but even the comparatively restricted quarters assigned to them in the new ape-house suffice to display their extraordinary agility and untiring activity. The briefest inspection of the gibbons here will reduce the most accomplished human gymnast to despair. Their flights are bewildering; it is so puzzling to realise

THE GIBBONS

how they get the impulse which carries them from point to point. The gymnast braces his muscles, holds his breath, and projects himself as a missile from a catapult when he springs for the high horizontal bar. A snapshot of a horse as he rises at a jump shows remarkable contraction of muscles. A bird bows its breast to the ground to get the necessary spring to launch itself into the air; and Herbert Spencer discovered that by making it impossible for a cockerel to raise himself to his full height upon his perch, the bird could be prevented from crowing untimely. But in the gibbon there is no evidence of exertion as it flies from tree to bar, from bar to chain. A Hainan gibbon which arrived at the Gardens in Regent's Park in 1904 had one arm useless through injury, yet its activity in climbing and swinging was phenomenal. How they acquire the power for their leaps with such little apparent exertion is as great a mystery to the layman as the light which the glow-worm kindles without any rise in temperature. The performance of one of the "Zoo" gibbons has been described in some detail by an observer:

"It is almost impossible to convey in words an idea of the quickness and graceful address of her movements; they may well be termed aerial, as



THE SILVERY GIBBON

she seems merely to touch in her progress the branches among which she exhibits her evolutions. In these feats her hands and arms are the sole organs of locomotion. Her body, hanging suspended as by a rope, sustained by one hand—the right, for example—she launches herself by an energetic movement to a distant branch, which she catches with the left hand; but her hold is less than momentary;

the impulse for the next launch is acquired; the branch then aimed at is attained by the right hand again, and quitted instantaneously, and so on, in alternate succession. In this manner spaces of twelve and eighteen feet are cleared with the greatest ease and uninterruptedly, for hours together without the slightest suggestion of fatigue being manifested; and it is evident that, if more space could be allowed, distances very greatly exceeding eighteen feet would be as easily cleared; so that Duvaucel's assertion that he has seen these animals launch themselves from one branch to another forty feet asunder, startling as it is, may well be credited. Sometimes in seizing a branch in her progress she will throw herself, by the power of one arm only, completely round it, making a revolution with such rapidity as almost to deceive the eye, and continue her progress with undiminished velocity.

"It is interesting to observe how suddenly this gibbon can stop, when the impetus given by the rapidity and distance of her swinging leaps would seem to require a gradual abatement of her movements. In the very midst of her flight a branch is seized, the body raised, and she is seen, as if by magic, quietly seated on it, grasping it with her feet. As suddenly she again throws herself into action. The following facts will convey some notion of her dexterity and quickness. A live bird was let loose in her apartment; she marked its flight, made a long swing to a distant branch, caught the bird with one hand in her passage, and attained the branch with the other hand, her aim, both at the bird and at the branch, being as successful as if one object only had engaged her attention. It may be added that she instantly bit off the head of the bird, picked its feathers, and then threw it down without attempting to eat it. On another occasion this animal swung itself from her perch across a passage at least twelve feet wide, against a window which it was thought would be immediately broken; but not so; to the surprise of all, she caught the narrow framework between the panes with her hand, in an instant regained the proper impulse, and sprang back again to the cage she had left—a feat requiring not only great strength, but the nicest precision."

This killing of the bird by the gibbon rather suggests a desire to kill for killing's sake, such as certain carnivora exhibit. But the gibbon, as we have already seen (page 198), has a taste for animal food, and, given a young bird, would readily eat it. An older bird would be seized with the same instinct; possibly lack of appetite would prevent its being eaten, or the age of the bird might make the gibbon reject it. An artist who was sketching the gibbons gave one of them a cockroach. The ape took it between its thumb and the lower part of its forefinger, and climbed with it up to its perch, and there greedily ate it, using the tips of the fingers of the hand which held the beetle to assist in climbing. The gibbon is a sure fly-catcher, and among the best of "mousers."

It is not surprising that gibbons should dwell together in unity when under restraint, since in their wild state they form large companies. They differ

in this respect from the captive oranges, which, moody and moping when alone, do not get on well in company. Another distinction between the two animals is that, whereas the free orang will carry off its dead from the hunter, whenever possible, the gibbon takes no notice of its dead fellow. This is the more surprising, seeing that the gibbon is the most solicitous of nurses. That the mother should take its little one to the stream and there wash it does not surprise more than the acts of some of the monkeys, but the attention bestowed on a sick and ailing gibbon by its mates deserves notice. A writer who was so fortunate as to have a number of gibbons free in his garden witnessed a striking example of the kind.

One of the apes, a young agile gibbon, fell from a tree and dislocated its wrist. It received the greatest attention from the others, especially from an old female, which, however, was no relation.

Before eating her own plantains, she used every day to take up the first that was offered to her, and give it to the cripple, who was living in the eaves of a wooden house. The same authority noticed that a cry of fright, pain, or distress from one would bring all the others at once to the complainer, and they would then condole with him and hold him in their arms.

There may be in the nature of the gibbon something of the cat's love of sporting with its prey. A spider is a delicacy which no gibbon's palate can withstand, yet the ape will play for a long time with the spider, dropping it from its fingers and letting it spin a ladder of descent. But in the end the spider will go the way of other spiders—towards making a meal for its captor. Tastes in gibbons differ, as in other animals. One, while a passenger on board ship, behaved itself with the greatest politeness, excepting when a dish of carrots appeared at table.

The gibbon's consuming passion for this vegetable mastered all sense of decorum. It would instantly leave its chair, mount the table, and, picking its way among the china, without overturning any article, pounce upon its favourite food, then remember its manners and retrace its steps to its chair, sated and penitent.

The tame gibbon is like a human child, in that it loves to do the things which, presumably, it knows it should not. One such is described in a familiar work. This ape had an irresistible fancy for disarranging the articles in the cabin in which it travelled with its master. Among these articles a piece of soap specially attracted its attention, and for the removal of this the ape had once or twice been scolded. One morning the author was writing, the ape being in the cabin. On glancing towards the ape, he saw it in the act of cautiously making for the soap. "I watched him without his perceiving that I did so; and he would occasionally cast a furtive glance towards the place where I was sitting. I pretended to write; he, seeing me busily occupied, took the soap and moved away with it in his paw. When he had walked half the length of the cabin, I spoke quietly, without frightening him. The instant he found I saw him, he walked back again and deposited the soap in the same place whence he had taken it." There was, however, something more than instinct in that line of conduct. Both by his first and last actions, the gibbon betrayed a consciousness of having done wrong.



THE CROWNED OR TUFTED GIBBON

E. A. B.

OLD WORLD MONKEYS AND BABOONS

ALTHOUGH there is some degree of uncertainty as to the precise significance to be attached to the names apes, monkeys, and baboons, it is convenient to restrict the first term to the man-like apes, and the second and third to those other Old World Primates which do not belong to the group of lemurs. The name monkey, however, is also applicable to one family of the Primates of the New World. Using, then, the terms monkeys and baboons in this sense, it may be mentioned, in the first place, that naturalists include the whole of those inhabiting the Old World in a single family, for which they adopt the name *Cercopithecidae* (which may be freely translated "tailed monkeys," from the Greek *kerkos*, "tail"; *pithekos*, "monkey"), taken from a genus of African monkeys. The next point is to consider how the numerous species comprised in the various genera are to be distinguished as a whole from the man-like apes, on the one hand, and from American monkeys, on the other.

As regards the number of their teeth, all the Old World monkeys and baboons agree with the man-like apes; the total number of teeth being thirty-two, among which there are two premolars and three molars on both sides of each jaw. This character, as we shall presently learn, will at once serve to distinguish any Old World monkey from an American monkey or marmoset. The Old World monkeys and baboons may, however, be distinguished from the man-like apes by the form of their cheek teeth. The premolar and molar teeth of the latter group, as we have already seen (page 175), closely resemble those of man, the crowns of the molars being relatively broad and surmounted by four low main tubercles situated at the four corners of each tooth, but arranged somewhat obliquely to its long axis. It may be added that the last molar in the lower jaw is of the same general form as the two teeth immediately in front of it.

If, however, the skull of any species of Old World monkey or baboon be carefully examined, it will be found that the molar teeth by no means accord with the foregoing description. We shall, indeed, recognise in these teeth the four tubercles at the corners; but instead of these tubercles being low, and set obliquely to one another, without any connection between those forming the front and hind pairs, they are comparatively high, and placed in pairs opposite one another; while each pair is connected by a low, imperfect transverse ridge. This two-ridged character of the molars, which is

more distinct in the lower than in the upper teeth, is therefore a readily available method of distinguishing between an Old World monkey or baboon and a man-like ape. Moreover, with the single exception of one African genus of monkeys, and one Oriental species of another, the last lower tooth of all the monkeys and baboons of the Old World may be distinguished from that of the man-like apes by having a kind of projection or heel behind the second transverse ridge.

There are, however, other characters distinctive of the present group which must now be mentioned. In the first place, in the nose of an Old World monkey the vertical partition dividing one nostril from the other is comparatively thin—this character affording a well-marked distinction from the monkeys and marmosets of the New World. It has been already stated that no man-like ape has a tail;

but there is great variation in this respect among the members of the present group, some having exceedingly long tails, others short tails, and a few no tails at all. In no instance, however, are the tails of this group endowed with the power of prehension, as they are in American monkeys. Here it may be observed that it has been often considered that the term monkey should be restricted to such species as have long tails, while those with short tails should be called baboons, and those with no tails at all apes. The arbitrary employment of terms, however, will not hold good when put in practice; since, if it were adopted, we should have to call certain of the



HEAD OF THE BLACK APE

Photograph by W. P. Dando

different species of one single genus of monkeys by all the three names.

In all the monkeys and baboons of the Old World those peculiar patches of hard, naked skin on the buttocks, known as callosities, already mentioned as occurring in the gibbons, are invariably present. These callosities, which are not unfrequently brightly coloured, afford another character by which an Old World monkey may at once be distinguished from its American cousins. Their use is to afford a comfortable rest for the body in the upright sitting posture assumed by the monkeys and baboons of the Old World.

Another feature absolutely peculiar to the monkeys and baboons of the Old World, although by no means common to the whole of them, is the presence of those pouches in the cheeks with which all who have fed tame monkeys must be familiar. These cheek pouches are formed by folds in the skin, and when empty lie flat on each side of the face.

They can, however, be so distended as to contain a large quantity of food, and then they stick out prominently on either side, so as to communicate a peculiarly bloated appearance to the face. The possession of these pouches must obviously be a great advantage to the monkey, since by their means a large quantity of food can be hurriedly gathered, stowed away, and afterwards eaten at leisure in some place of security. It might, indeed, be urged that the monkeys which do not possess these convenient receptacles appear to get on in life quite as well as their relations which are thus provided, and that, consequently, these pouches are of no real benefit to the owners of them. To this it may be replied that such Old World monkeys as have no cheek pouches feed much more on leaves and shoots than on fruits; and that they are furnished with a peculiarly complex stomach in which this food can be rapidly stowed away before undergoing complete digestion.

With regard to the limbs of Old World monkeys and baboons, it may be observed that the arms never present that great excess in length over the legs which we have seen to characterise the man-like apes; and the legs may, sometimes, be the longer of the two. The thumb of the Old World monkeys and baboons can in all cases be fully opposed to the fingers, except, of course, in those African species in which it is either absent or rudimentary, and therein lies another marked point of difference from the American group.

Finally, the skeletons of all members of the present group may be readily distinguished from those of the man-like apes by the breastbone being narrow and flattened from side to side instead of broad and flattened from back to front. Moreover, all the species have a central bone in the wrist—a characteristic they have in common with the gibbons and the orang-utan among the man-like apes.

Such, then, are the leading features by which the monkeys and baboons of the Old World—forming a larger group than any other in the order—are distinguished from the groups immediately above and below them in the zoological scale; and the student ought to be able to tell at once whether any particular monkey should or should not be included in the present group. When we speak of the members of this group occupying a position immediately below that of the man-like apes, we must guard ourselves from conveying the idea that the latter can in any sense be regarded as the ancestors of the other. The difference in the structure of the molar teeth of the two groups is alone sufficient to prove that this cannot be the case, those of the man-like apes being of a more primitive type than are those of the monkeys and baboons. The common ancestor of the two groups should perhaps be sought in some long extinct type more nearly akin to lemurs.

Although the majority of Old World monkeys and baboons are inhabitants of the warmer regions of the Eastern hemisphere, yet the group is by no means so strictly confined to tropical and sub-tropical regions as is the case with the man-like

apes, which, in a state of nature, are not met with outside of the warm regions of the earth. Indeed, some of the Asiatic species are capable of withstanding a very considerable degree of cold, and may be found among the snows of the Himalaya and North-Western China.

THE LANGUR MONKEYS

With this group of long-tailed Asiatic monkeys, which constitute the genus *Semnopithecus*, we come to the first of four nearly allied genera, characterised by their extremely slender and "lanky" build, by the excessive length of their tails, by the legs being longer than their arms, and by the absence of cheek pouches. All these distinctive features can be verified in the living animal, but there is one other for the examination of which we must turn to the anatomist. This internal character relates to the stomach, which, instead of having the simple bladder-like form which it assumes in all other members of the order, is divided into a number of pouches or sacs. When the peculiar pouched stomach was first described scarcely anything was known as to the habits and food of the monkeys in which it is found. Sir Richard Owen, however, suggested from the analogy presented by this peculiar type of stomach to the one characterising ruminants, as well as some other vegetable-feeding animals, that the food of these monkeys consisted in great part of leaves. This surmise was fully confirmed by subsequent observations; and although the habits of the langurs are still imperfectly known, yet it is stated that they are more purely herbivorous than those monkeys which are provided with cheek pouches, and that a very considerable portion of their food consists of leaves and the tender shoots and young twigs of trees. The presence of this remarkable kind of stomach is, indeed, a kind of compensation for the absence of cheek pouches, being more suited to the needs of these animals than pouches would be.

The langurs are so-called from the name applied by the natives of Northern India to those species of the group which inhabit the outer ranges of the Himalaya. Langurs, which are known in Germany as *Schlänkaffen*, or slender monkeys, are found over a large portion of South-Eastern Asia, being especially abundant in India and Burma, and represented by one species in the highlands of North-Western China.

As their German name implies, the bodies and limbs of these monkeys are exceedingly slender; while the tail is so long that very generally, and invariably in all the species from India, Ceylon, and Burma, it is actually longer than the whole length of the head and body together. This is shown in the figure of the hanumán monkey on page 211. In all the species the thumb is well developed; this being a character of great importance, and the chief one by which the members of this group are distinguished from some closely allied African monkeys. The row of long, stiff black hairs, seen in the figure, projecting from above the eyebrows of the langurs is another feature, by which these monkeys may

THE LANGUR MONKEYS

be easily recognised. Further, the skulls of all the langurs may be readily distinguished from those of other monkeys, with the exception of the allied African group mentioned above, by the circumstance that the aperture for the nostrils, which is exceedingly narrow, extends upwards between the sockets for the eyes, instead of stopping at about the level of their lower border.

Almost the earliest account that we have of the langurs relates to those of Ceylon, and was given in the year 1681 by Robert Knox, an English seaman, who for nearly twenty years had been a prisoner in that island. Knox says that some of the Sinhalese monkeys "are as large as our English spaniel dogs, of a darkish-grey colour, and black faces, with great white beards round from ear to ear, which make them show just like old men. They do but little mischief, keeping in the woods, eating only leaves and buds of trees; but when they are caught they will eat anything. This sort they call in their language wanderows." It was thought that Knox alluded to the lion-tailed monkey, formerly incorrectly called the wanderu; but this is black, and there is no doubt that he described the langurs, which are the wanderus of the Sinhalese.

THE HANUMÁN

Perhaps the best-known of all the langurs, and the one which gives the scientific name (derived from the Greek *semnos*, "sacred") to the genus, is the hanumán monkey, or true langur (*Semnopithecus entellus*). It is found throughout the northern part of India, from South-western Bengal and Orissa to Gujerat and Bombay, and also occurs in Kathiawar, and probably Cutch, although unknown in Sind and the Punjab. Southwards it ranges into the Bombay Deccan; while its extreme northern limit extends to the outer ranges of the Himalaya, although there is still some doubt as to where the range of this species ends and that of the next begins.

The hanumán is one of several species of Indian langurs characterised by having the hair covering the crown of the head radiating in all directions from a central point situated on the forehead. It is distinguished from its allies by the absence of any crest of hair on the head, of which the colour is scarcely, if at all, paler than that of the back, and by the full black of the upper surfaces of the hands and feet. The hair of the cheeks does not cover the relatively large ears. The general colour is greyish brown, paler in some individuals than in

others; but the face, ears, feet, and hands are coal black. In size a large male hanumán will measure some 30 in. in head and body; but average specimens will be about 25 in., while their tail will measure as much as 38 in. The general appearance is so peculiar that no one who has once been told of a large, long-limbed, slender monkey, with a prodigious tail, black face, and overhanging brow of long, stiff, black hair projecting like a penthouse, can fail to recognise the hanumán (pages 171, 211).



HANUMÁN MONKEYS

Langurs are exceedingly common throughout a large part of India, and in most districts are held sacred by the Hindus, by whom they are allowed to plunder the grain-shops at will. The best times of the hanumán are, however, ended, as it is not allowed the free run of the bazaars so readily as it once was, while in some districts the aid of Europeans has been invoked to rid the natives of the devastations of these monkeys, which take their name from the god

Hanumán, to whom they are sacred.

The protection accorded to the hanumán by the Hindus of Northern India has caused these monkeys to be so tame, and so utterly regardless of the presence of man, that there are but few mammals whose habits can be so well observed. The hanumán is usually found in smaller or larger communities, composed of individuals of both sexes and of all ages, the youngest clinging to their mothers, and being carried by them, especially when alarmed. As with so many other mammals, an old male is occasionally found solitary. The story that males and females live in separate troops appears to be fictitious, though females with very young offspring may keep together and temporarily apart from the remainder of the troop to which they belong.

In regard to the cry of these langurs, Dr. Blanford observes that "their voice is loud, and is often heard, especially in the morning and evening. The two commonest sounds emitted by them are a loud, joyous, rather musical call, a kind of whoop, generally uttered when they are bounding from tree to tree, and a harsh, guttural note, denoting alarm or anger. The latter is the cry familiar to the tiger-hunter, among whose best friends is the hanumán. Safely ensconced in a lofty tree, or jumping from one tree to another as the tiger moves, the monkey by gesture and cry points out the position of his deadly enemy in the bushes or grass beneath, and swears at him heartily. It is marvellous to observe how these monkeys, even in the wildest forests where human beings are rarely seen, appear to recognise men

as friends, or at least as allies against the tiger. It is a common but erroneous notion of sportsmen that this guttural cry is a sure indication of a tiger or leopard having been seen, whereas the monkeys quite as often utter it merely as an expression of surprise; I have heard it caused by the sight of deer running away, and I believe that it is frequently due to the monkeys catching sight of men."

The food of the hanumán consists largely of leaves and young shoots, and also grain of all kinds, especially in the towns. In disposition this monkey is gentle, and appears never to attack human beings. Its constitution is delicate when in captivity—probably from the want of suitable food,—but the species is generally well represented in the London Zoological Society's Gardens.

THE HIMALAYAN LANGUR

So closely related to the hanumán is the Himalayan langur (*S. schistaceus*) that it ought, perhaps, to be reckoned merely as a local race of that species. The Himalayan species is characterised by being somewhat larger—although there is probably no great difference between large individuals of both species; by the head being much paler in colour than the back, and by the feet being little, if at all, darker than the limbs; by the smaller ears, which are concealed by the long hair of the cheeks, and by the form of the skull.

This species is found throughout the greater part of the Himalaya proper, ranging from Bhutan in the south-east to the Kashmir valley and adjacent regions in the north-west. It appears not to be found below 5,000 feet, and in the interior of Sikkim it ranges as high as 12,000 feet. One of the first, if not actually the first, to record the occurrence of the Himalayan langur in the interior of Sikkim was Sir Joseph Dalton Hooker in his "Himalayan Journals." The author of that charming book of travel says, on arriving at a Tatar village, at an elevation of about 9,000 feet, he saw a troop of large monkeys gambolling in a wood of *Abies brunoniana*; this surprised him, as he was not prepared to find so tropical an animal associated with a vegetation typical of a northern climate. Other writers have observed these langurs in the outer ranges of the Himalaya in the neighbourhood of the hill stations of Simla or Mussuri, leaping from bough to bough of the snow-clad pines and deodars. And I myself was once sufficiently fortunate to behold a similar sight when crossing a pass called the Rutten Pir, in the mountains to the south of the valley of Kashmir. On a sudden, when passing through a forest composed partly of pines and deodar cedars and partly of rhododendrons, a whole troop of these langurs dashed across the path, springing from tree to tree, and scattering in all directions the thick wreaths of snow with which the dark fir boughs were concealed, the season of the year being the middle of the spring.

In the autumn these langurs are to be found in large droves in the extensive forests of the higher valleys surrounding Kashmir. Here they are a decided nuisance to the hunter, as their cries will not

unfrequently alarm the deer or bear which he may be pursuing. I was once tempted to shoot a male, but the cries and expression of the wounded brute were so human-like that I never again shot a monkey of any kind.

THE MADRAS LANGUR

In Madras and Ceylon the hanumán is represented by an allied species known as the Madras langur (*S. priamus*), distinguished by a distinct crest of hair on the crown of the head, and by the upper surfaces of the feet and hands not being black. The following account of the habits of this species is taken from Sir J. Emerson Tennent's "Natural History of Ceylon," in which, as we have said, the langurs are described as wanderers. The Madras langur "inhabits the northern and eastern districts, and the wooded hills which occur in these portions of the island. In appearance it differs both in size and colour from the common wanderer (*S. cephalopterus*), being larger and more often greyish; and in habits it is much less reserved. At Jaffna, and in other parts of the island where the population is numerous, these monkeys become so familiarised with the presence of man as to exhibit the utmost daring and indifference. A flock of them will take possession of a palmyra palm; and so effectually can they crouch and conceal themselves among the leaves that, on the slightest alarm, the whole party becomes invisible in an instant. The presence of a dog excites, however, such an irrepressible curiosity that, in order to watch his movements, they never fail to betray themselves. They may frequently be seen congregated on the roof of a native hut; and some years ago the child of a European clergyman stationed near Jaffna, having been left on the ground by the nurse was so teased and bitten by them as to cause its death."

The Malabar langur (*S. hypoleucus*), which is common not only in the forests, but likewise on the cultivated lands fringing the Malabar coast, is another member of the group in which the hair of the crown of the head radiates from a single point on the forehead.

THE BANDED LANGUR

A rare monkey from Sumatra, Borneo, and the Malay Peninsula, extending as far north as Tenasserim, is the banded langur (*S. femoralis*). It differs from those already mentioned in that the hair of the crown of the head radiates from two distinct points on the forehead. The hair on the hind part of the head stands up so as to form a crest; while that over the temples bends forwards to overhang the eyes. In colour this monkey is much darker than any of the foregoing species, varying from blackish brown to black over the greater part of the body, but white over a larger portion of the under surface of the body and inner sides of the thighs; the white area always including the abdomen. The young are of a whitish hue throughout.

A closely allied, if not identical, kind of langur from the same regions is called *S. chrysomelas*, and differs merely in some details of colouring.



THE MANDRILL

The whole aspect of this creature, one of the largest of baboons, "is far more suggestive of the forms imagined during a nightmare than is the case with any other living mammal."



BABOONS IN THEIR ROCKY HOME

These dog-headed animals "show an especial predilection for rocky quarters, and are accustomed to go in large troops for common defence against leopards and other formidable carnivores.



HANUMÁN MONKEYS

The hanumán monkey is very common in India, and in most districts is "held sacred by the Hindus, by whom it is allowed to plunder the grain-shops at will."



GROUP OF MACAQUES

The macaques have a varied appetite, and though chiefly eaters of fruit, seeds, and insects, are known to devour lizards at times, while one species prefers crabs. The two foremost in the above group are the lion-tailed and the bonnet monkeys.

THE LANGUR MONKEYS

It is a curious circumstance that the skulls of both these species or races of langurs may be distinguished from those of all others by the form of the last molar, or "wisdom-tooth," in the lower jaw. In all the other langurs this tooth has five tubercles; in the banded species it has but four, as in the undermentioned group of guenons.

THE NEGRO LANGUR

Far better known than the last species is the negro monkey (*S. maurus*), or buden, as it is called by the Javanese. This langur, which was originally obtained from Java, but is also found in Sumatra and the Malay Peninsula, takes its English name from the full black colour prevailing over all the body in the adult, except a portion of the under surface and the root of the tail, where it is replaced by grey. It agrees with the banded langur in the forward projection of the hairs on the front of the crown, as is well shown in the figure on page 214. The length of the head and body of this monkey is about 24 in., the tail being longer than the head and body, and frequently furnished with a small tuft at the extremity. The young are light-coloured, being of a yellowish or reddish tint, the dark colour of the adult appearing first on the hands, and then gradually spreading over the limbs and body. This light colour of the young shows that the dark tint of the adults is an acquired or specialised character.

Nearly allied to this species is another and much rarer monkey, found in Java, where it is called by the natives the luton. It is known scientifically as *S. pyrrhus*; and it differs from the negro langur in being of a rusty red colour at all ages, and is therefore evidently a less specialised form. So like, indeed, are the two that the luton was long considered to be merely a light-coloured variety of the buden. It has, however, been shown that the skulls of the two present considerable structural differences, and indicate perfectly distinct species.

Although in Java these two monkeys have distinct names, the Malays call both by the name luton, distinguishing the negro langur as the luton itam, and the red species as the luton mora; the words "itam" and "mora" signifying respectively black and red.

The opinion that these two monkeys are distinct species is confirmed by a marked difference in their disposition, as was pointed out by Dr. Horsfield, from whose work on the "Zoology of Java" the following account, with some slight verbal alterations, is taken. After observing that the black buden is much more abundant than the red luton, the author observes that "the latter, both on account of its rarity and comparative beauty, is a

favourite with the natives. Whenever an individual is obtained, care is taken to domesticate it, and it is treated with kindness and attention. The buden, on the contrary, is neglected and despised. It requires much patience in any degree to improve the natural sullenness of its temper. In confinement, it remains during many months grave and morose; and, as it contributes nothing to the amusement of the natives, it is rarely found in their villages or about their dwellings. The buden is found in abundance in the forests of Java; it forms its dwelling in trees, and associates in numerous societies. In meeting them in the forests, it is prudent to observe them at a distance. They emit loud screams on the approach of a man, and by the

violent bustle and commotion excited by their movements, branches of decayed trees are not unfrequently detached, and thrown down on the spectators. They are often chased by the natives for their fur. In these pursuits, which are generally ordered and attended by the chiefs, the animals are attacked with cudgels and stones, and cruelly destroyed in great numbers. The skin is prepared by a simple process, which the natives have acquired from Europeans; and they conduct it with great skill. It affords a fur of a jet black colour, covered with long silky hairs, which is usually employed, both by natives and Europeans, in preparing riding equipages and military decorations."



THE WHITE LANGUR
Photograph by Lewis Medland

THE CRESTED LANGUR

The crested luton, or langur, of Sumatra and Borneo is closely allied to the negro langur, from which it appears to be chiefly distinguished externally by the blackish fur being usually grizzled, or washed with greyish white. A male from Sumatra has been described as of a brownish black colour, with a dusky tinge on the flanks, forearms, and crest; the short crest on the vertex of the head being directed backwards, and the long, black hair on the temples coming forwards. The female is black, with the tips of the hairs on the head and body of a lustrous grey tint; the hair of the limbs being yellowish grey, except on the hands and feet, where they are black. On the under parts the hair is paler, with yellowish grey tips; while the tail is black, tipped with grey above but yellowing underneath, more especially near the root. The face is bluish black. The young is yellow; and there is stated to be a race in which the colour of the adult is either light grey or whitish.

THE NILGIRI LANGUR

With the Nilgiri langur we come to the first of a large group of langurs in which the hair of the crown,

instead of radiating from one or more points on the forehead, is uniformly directed backwards without any trace of parting. This species (*Semnopithecus johnei*, which derives its Latin name from a former member of the Danish factory at Tranquebar in Madras, belongs to a subgroup characterised by the absence of a crest of hair on the crown of the head; the hair of the crown itself being not longer than that on the temples and the nape of the neck. The Nilgiri langur is a comparatively small species, the length of the head and body varying from about 21 to 23 in., and that of the tail from 32 to 35 in.; though larger individuals are occasionally met with. The hair of the body is long, fine, and glossy; and the general colour black to blackish brown, with the exception of the head and rump, of which the former is brownish yellow, and the latter ashy grey. The young of this monkey are black throughout, and this appears also to be the case in the purple-faced langur. This character serves, therefore, to distinguish these langurs very markedly from those of the preceding group, in which the young are light-coloured; and it may be taken as an indication that the present group is the most specialised of all the langurs, not only having acquired the black tint in the adult, but even in the earlier stages of existence.

As its name implies, this langur is found in the Nilgiri Mountains (or Hills; as they are commonly called by Anglo-Indians) of Southern India; and its range extends from the Wynad southwards to Cape Comorin.

According to Dr. W. T. Blanford, this langur "is shy and wary, the result of human persecution. It inhabits the *sholas*, or dense but abruptly limited woods of the Nilgiris, and other high ranges of Southern India, and is also found in the forests on the slopes of the hills, usually in small troops of from five to ten individuals. It is very noisy, having a loud guttural alarm-cry, used also to express anger, and a long, loud call. Jerdon relates that when the *sholas* of the Nilgiri range were beaten for game, these monkeys made their way rapidly and with loud cries to the lowest portion, and thence to a neighbouring wood at a lower level." These monkeys are frequently shot for their beautiful skins, hence their shyness.

THE PURPLE-FACED LANGUR

The purple-faced langur (*S. cephalopterus*) is the representative of its group in Ceylon. It is known to be liable to considerable variations of colour, and

the Sinhalese langurs, known as the white monkey (*S. senex*), and the bear monkey (*S. ursinus*), may be regarded as nothing more than well-marked races or varieties of this species.

There is a ready means of distinguishing the purple-faced langur from the Nilgiri langur. In the latter the cheeks are of the same brown colour as the rest of the head; in the former they are always much paler than the crown. Typically, this species is of small size, the length of the head and body being only 20 in., and that of the tail $24\frac{1}{2}$ in. The so-called bear monkey is, however, somewhat larger, the length of the head and body being 21 in., and that of the tail 26 in. In colour, the typical purple-faced langur varies from dusky to smoky brown and black, more or less tinged with grey on the back and upper parts, this grey being always present on the haunches. In the head the long whiskers on the cheeks stand out in striking contrast to the brown hue of the rest of the head. Some varieties are more decidedly brown; and in the bear monkey, dusky brown is the prevalent hue, with complete absence of grey on the haunches. The white monkey, which

may be regarded merely as a variety of this species, is a curious-looking creature of a general yellowish white colour, with a faint brownish tinge on the head, and tending to a dusky hue on the shoulders and down the middle of the back. The face and ears retain the usual black hue, but the palms of the hands and the soles of the feet are flesh-coloured.

The typical form is found over the greater part of Ceylon at low or moderate elevations, and apparently not ascending above some thirteen thousand feet above the sea-level. The bear and white monkeys, however, are confined to the southern parts of Ceylon, and ascend to much higher elevations; the former variety being especially abundant in the lofty mountains in the neighbourhood of the town of Nuwera Ellia.

Sir Emerson Tennent, writing of the typical purple-faced langur, which he terms the wanderer of the low country, states that it is far the commonest of the Sinhalese langurs, and that "it is an active and intelligent creature, little larger than the common bonneted macaque, and far from being so mischievous as the other monkeys in the island. In captivity it is remarkable for the gravity of its demeanour, and for an air of melancholy in its expression and movements which are completely in character with its snowy beard and venerable aspect. In disposition it is gentle and confiding, sensible in the highest degree



THE NEGRO LANGUR

THE LANGUR MONKEYS

of kindness, and eager for endearing affection, uttering a low, plaintive cry when its sympathies are excited. It is particularly cleanly in its habits when domesticated, and spends much of its time in trimming its fur and carefully divesting its hair of particles of dust. Those which I kept at my house near Colombo were chiefly fed upon plantains and bananas, but for nothing did they exhibit a greater partiality than for the rose-coloured flowers of the red hibiscus. These they devoured with unequivocal gusto; they likewise relished the leaves of many other trees, and even the bark of a few more of the succulent ones."

Tennent goes on to mention that in the hills the typical black form of this monkey is replaced by the so-called bear monkey. "The natives, who designate the latter as the maha, or great, wanderu, to distinguish it from the kala, or black one (the typical purple-faced monkey), with which they are familiar, describe it as much wilder and more powerful than its congener of the lowland forests. It is rarely seen by Europeans, this portion of the country having till very recently been but partially opened; and even now it is difficult to observe its habits, as it seldom approaches the few roads which wind through these deep solitudes. At early morning, ere the day begins to dawn, its loud and peculiar howl, which consists of a quick repetition of the sounds 'how, how!' may be frequently heard in the mountain jungles, and forms one of the characteristic noises of these lofty situations." There is a record of one of these monkeys having attacked a native laden with a bag of rice.

THE CAPPED LANGUR

Of somewhat smaller dimensions than the hanu-mán is the capped langur (*S. pileatus*) of Assam and the neighbouring districts of North-Eastern India and Upper Burma. This species may be readily distinguished from the Nilgiri langur and the purple-faced monkey, with its varieties, by the hair of the crown of the head being longer than that on the occiput and temples, thus presenting somewhat the appearance of a cap, from which character the species derives its name.

In colour this monkey varies from dusky grey to a brownish ashy grey on the upper parts; the upper portion of the back, and sometimes also the crown of the head, being darker. The hands and feet are dark or black above, but occasionally some or all of the fingers may be yellowish. The tail is dark brown, but may be black at the tip. The face is

always black, but the sides and lower parts of the head, as well as the neck, vary from a golden brown or orange to a pale yellow or yellowish white tint. The light colour of the sides of the face extends backwards to a line just above the ears, so that, with the light-coloured nape of the neck, the dark cap is well defined, and gives to this monkey a peculiar and distinctive appearance.

The red-bellied langur (*S. chrysogaster*) is a little-known species, reputed to have been obtained from Tenasserim. In the adult, the upper parts, the limbs, and the tail are jet black, with the lower portions of the individual hairs ruddy, and their extreme bases white; the band on the forehead, as well as the cheeks to behind the ears, and the sides and front of the neck, together with the chin and the upper part of the breast, are pure white. The remainder of the under parts are of a deep bright ferruginous red, which also tinges the inner sides of the limbs, and gives the animal its distinctive appellation. The young are of a uniform reddish white colour. The head of the adult appears to have a small crest, and by this it is distinguished from the typical capped langur.



THE PURPLE-FACED LANGUR
Photograph by Lewis Medland

THE DUSKY LANGUR

The dusky langur (*S. obscurus*), found in Siam, the Malay Penin-

sula, and the Tenasserim provinces, while agreeing with the Nilgiri and the capped langur in the backward direction of the hair on the crown of the head, is characterised by a distinct crest of longer hairs on the occiput, arranged in a pointed form.

Closely allied to this species is Phayre's langur (*S. phayrei*), distinguished by the crest of hair being placed on the crown of the head instead of on the occiput, and by this same crest being compressed and longitudinal, instead of pointed, while the colour of the body is dark grey above, and whitish underneath. Phayre's langur inhabits Arakan, part of Pegu, and Northern Tenasserim.

HOSE'S LANGUR

This handsome and peculiarly coloured langur (*S. hosei*) from Borneo belongs to the group in which the hair of the crown extends evenly backwards. It is about the same size as the dusky langur. The crown has a longitudinal crest, starting about half an inch behind the centre of the forehead. The general colour of the body is a hoary grey, caused by the mixture of black and white hairs. The crest, as well as the centre of the crown of the head, the nape of the neck, and the eyebrows, are deep glossy black, and the hands and feet are of



THE ORANGE SNUB-NOSED MONKEY

the same jetty hue. In marked contrast to these sombre tints is the brilliant white of the forehead, temples, sides of the head and neck, and chin. This white is continued down the throat and chest to the under surface of the body, and the inner sides of the upper parts of the limbs. This handsome species differs from all the langurs yet mentioned in the marked contrast presented by its black crest to the brilliant white of the temples and cheeks.

Another monkey from Borneo has been named *S. thomasi*, but comes very close to Hose's langur.

THE DOUC

The douc, or variegated langur (*S. nemæus*), is an inhabitant of the forests of Cochin China, where it is found near the coast, as well as in the interior, and is remarkable for its brilliant colouring. The general form of the douc is so different from that of other langurs that it has been made the type of a distinct genus. The build is more robust, and the limbs are stouter, and of nearly equal length, whereas, in the typical langurs, the arms are considerably shorter than the legs.

The hair on the top of the head is directed backwards, without any crest; and the brilliant white whiskers have likewise the same direction, and are closely pressed to the face. The general colour of the head is brown, but there is a narrow band of bright chestnut passing backwards under the ears, and the naked face is of a brilliant yellow, which makes a bold contrast to the pure white whiskers. Owing to the hairs of the body having alternate dark and light rings of colour, the general tint of the body is a mottled, grizzled grey, darker on the upper than on the under parts. The upper parts of the arms and legs, as well as the hands and feet, are deep black; but the lower portions of the legs are chestnut, and the forearms white. A large patch on the rump near the root of the tail, as well as the tail itself, is likewise white.

As might naturally be supposed, fossil remains of langurs have been found in their native land of India. Some of these have been obtained from caverns in the Madras Presidency, and do not date back much, if at all, beyond the human period. Other remains occur, however, in the much older Siwalik sandstones forming the ranges on the flanks of the Himalaya, and belonging to the upper part of that division of the Tertiary period known to geologists as the Pliocene. This does not, however, by any means limit the range of extinct langurs, since their remains have been found in the Pliocene deposits of the Val d'Arno in Tuscany, and also in strata of equivalent age in the South of France. We have, therefore, evidence that these monkeys, which are now confined to the Indo-Malay and Chinese countries, were formerly widely spread over the Eastern hemisphere.

THE SNUB-NOSED MONKEYS

Perhaps the last place in which we should expect to find a living monkey would be the highlands of North-Western China. This monkey (*Rhinopithecus roxellana*) may be recognised among all its congeners by its "tip-tilted" nose. Although short and small, the nose is so much turned up that its tip reaches to the level of the lower border of the eyes. This monkey differs from the langurs in its stouter build, and relatively shorter limbs. The upper surface of the body, the crown of the head, the outer sides of the limbs, and the whole of the tail are an olive brown colour, flecked with golden yellow; while the sides of the face, the lower part of the forehead, and all the under parts and the inner sides of the limbs, are brilliant yellow, tending to orange, the naked parts of the face being bluish grey. The males, which are nearly double the size of the females, develop very long winter coats, with beautiful tufts or tresses of long, silky, golden hair on the back. These monkeys inhabit the forests of the mountain region between Moupin, in Sze-chuen, and Lake Khoko, where snow lies for a large portion of the year. They are stated to live in numerous troops, always ascending the loftiest trees, and feeding on fruits, but, when pressed by hunger, eating also the leaves and shoots of the bamboo. From its colour, this species is called the orange snub-nosed monkey. A second member of the group, the slaty snub-nosed monkey (*R. bieti*), inhabits the Upper Mekon Valley, and has a coat of a uniformly slaty grey colour. A third species is *R. brelichi*, of Central China.

THE PROBOSCIS MONKEY

If the physiognomy of the snub-nosed monkey appear ludicrous, it is hard to say what epithet ought to be applied to the far more grotesque-looking creature represented in the figure on p. 217. The nose of the proboscis monkey (*Nasalis larvatus*) is, indeed, so enormous in proportion to the face that it presents the appearance of an absolute deformity, and it is very difficult to imagine of what possible advantage it can be to its owner.

THE PROBOSCIS MONKEY

The proboscis monkey is an inhabitant of Borneo, and its marked difference from other monkeys is one of the many proofs indicating the great antiquity of that island, and the long period during which it has been isolated from other lands. In general structure this monkey conforms so closely to the langurs that the peculiarity of its nasal organ would not alone justify its separation from that group as the representative of a distinct genus, although it was on this ground solely that the separation was originally made. Subsequent researches have, however, shown that the skull can be distinguished at a glance from that of any of the langurs, and also from those of the African genus *Colobus*, to be mentioned immediately, by the form of the aperture of the nasal cavity. Thus, whereas in the latter this aperture extends upwards between the sockets of the eyes, in the proboscis monkey the nose bones which roof over this aperture descend considerably below the lower margin of the eye sockets. In this respect the species under consideration resembles the macaques and their allies.

The proboscis monkey was first made known to European science in 1781 by Baron Wurmb, sometime Dutch governor of Batavia. Wurmb described it under the name kahau, a term apparently made up from a resemblance to its cry, but unknown to the native inhabitants of Borneo, by whom it is said to be called bantugan. Specimens were subsequently sent to Europe, which were considered to indicate two distinct species; but it was afterwards discovered that these supposed two species were founded upon the male and female of the one and only proboscis monkey, in which the two sexes differ considerably in point of size.

The proboscis monkey is a rather large animal, the combined length of the head and body of the male being about 30 in., while the tail measures some 27 in. The general colour is a kind of ochre yellow, the head and upper parts of the body being chestnut. The under parts are lighter; a large patch on the rump above the root of the tail, as well as the tail itself, together with the forearms and the lower portion of the legs, being greyish yellow. The forehead is very low, and the dark chestnut hair directed backwards from a nearly straight line immediately over the eyes,

while the hair of the temples is continued down the sides of the face as whiskers, which meet as a beard beneath the chin. The whole of the large naked face is, therefore, surrounded by a hairy frame. In stuffed or dried specimens the skin of the face fades to a dull leaden hue; but when the animal is alive the skin is of a reddish brown flesh colour.

The light-coloured area on the loins near the root of the tail usually takes the form of a number of large rectangular spots, producing a peculiar and characteristic kind of colouring, which is, however, absent in the female.

According to a photograph taken a few years ago from a living example the form usually given to the nose in mounted specimens and figures of the proboscis monkey is quite incorrect. Instead of being sharply pointed, compressed, and projecting straight forwards, this appendage is expanded and depressed at the extremity, which hangs down in front of the upper jaw so as to conceal the greater part of the mouth in a full-face view.

The enormous nose, from which the creature derives both its popular and scientific appellation, has the nostrils placed on its under surface, although separated by a much narrower septum than in man. This excessive development of the nose is, however, only reached in the adult male; it being much less throughout life in the female, while in the young of both sexes it is comparatively small, and upturned as in the snub-nosed monkey.

Accounts of the habits of the proboscis monkey in its wild condition are few. The following note is taken from a translation of the original account given by Baron Wurmb. After stating that these monkeys are found in large troops, the author says that "they assemble together morning and evening, at the rising and

setting of the sun, and always on the banks of some stream or river; there they may be seen seated on the branches of some great tree, or leaping with astonishing force and rapidity from one tree or branch to another, at a distance of fifteen or twenty feet. It is a curious and interesting sight; but I have never remarked, as the accounts of the natives would have you believe, that they hold their long nose in the act of jumping; on the contrary, I have uniformly observed that on such



THE PROBOSCIS MONKEY



YOUNG PROBOSCIS MONKEY

Photograph by W. P. Dando

occasions they extend the legs and arms to as great a distance as possible, apparently for the purpose of presenting as large a surface as they can to the atmosphere. The nature of their food is unknown, which renders it impossible to keep them alive in a state of confinement."

THE GUEREZA MONKEYS

The langurs, which, as already mentioned, are widely distributed over South-Eastern Asia, and more especially that portion forming the Oriental region of zoologists, are replaced in Africa by a group of monkeys closely allied to them in all respects, but distinguished either by the total absence or rudimentary condition of the thumb. When present at all, this digit merely takes the form of a small tubercle, which may or may not be provided with a minute nail. Such a point of difference from the langurs is rightly regarded as worthy of generic distinction, and these African monkeys have accordingly been described under the name of *Colobus*, from a Greek word meaning "docked," in allusion to the feature in question. There is no popular name by which these monkeys are generally known, but it seems best to apply the native name guereza to the whole group, although this strictly belongs only to certain black-and-white species from Abyssinia and North-East Africa.

There are about a dozen species of this group known to science. Our acquaintance with their habits is, however, extremely imperfect, and few of them have been brought alive to Europe, since, like their cousins the langurs, they are delicate, and do not thrive well in confinement. The sacculated, or pouched, stomach indicates that their food, like that of the langurs, is in all probability largely composed of leaves and twigs. If, however, their habits at all resemble those of the group last mentioned, it is not easy to see why they should have lost their thumbs—unless, indeed, the small thumbs of their Indian cousins are practically useless.

Although several of the guerezas are met with in East Africa, these monkeys attain their maximum development on the west coast, where they were

formerly very abundantly represented. Most of them are remarkable for the length and beauty of the silky hairs with which their bodies are clothed, their fur being largely imported into Europe for use as trimming for other furs and various kinds of apparel.

Before noticing some of the species of this group it may be mentioned that the hair of all the guereza monkeys is coloured uniformly, and by this character even a small piece of their fur may be distinguished from that of most other African monkeys, in which each individual hair is ringed with different hues.

THE BLACK-AND-WHITE GUEREZA

This handsome species (*Colobus guereza*) occurs typically in Central Abyssinia in the neighbourhood of Simien. In Southern Abyssinia it is comparatively common in the district of Gojam, and thence it extends southwards into the Galla country. From the Galla country and Somaliland this guereza appears to range to the south-west into the Niam Niam district, lying to the north-west of Albert Nyanza, and southwards as far as Kilimanjaro on the east coast. Westwards it ranges into the upper part of the Congo valley. The East African representative of the species is distinguished as *Colobus caudatus*, and the Congo and Unyoro form as *C. occidentalis*. Both, however, should perhaps be regarded as races rather than species.

The head, body, and limbs of the black-and-white guereza are covered with jet black hair of moderate length; but on either side of the back there arises a line of long hair, hanging down below the flanks, and forming a kind of mantle of pure white. The dark face is also surrounded with a fringe of white hair, which forms long whiskers lying flat on the cheeks, and directed backwards. The long tail terminates in a white tuft. The contrast of the white of the mantle, of the cheeks, flanks, and tail against the velvety black of the rest of the body is most striking and without exact parallel among other mammals, although the colouring of the skunk is somewhat suggestive of it (see page 17).

Handsome as is the typical guereza in these



THE FLAG-TAILED GUEREZA

THE GUEREZA MONKEYS

respects, it is exceeded by the aforesaid East African species or race, which occurs commonly at an elevation of about three thousand feet on the sides of Kilimanjaro. In the typical species the first twelve or sixteen inches of the tail are black and short-haired, the white tufted portion including only the last eight or ten inches; while the white mantle of hair depending from the back conceals only about one-third of the black portion of the tail. In the East African flag-tailed guereza (*C. caudatus*), only some three or four inches of the base of the tail are black and short-haired, while the remainder is covered with long white hair for a length of some twenty inches, each hair measuring from eight to nine inches. Moreover, the white hairs of the mantle entirely conceal the black of the root of the tail, so that the mantle and tail-brush practically become continuous. In another race (*C. sharpei*), inhabiting Northern Nyasaland, the white on the head and body is restricted to the forehead, and a long tuft of hair on each side of the nape. The guereza lives in small companies, and is constantly on the move, but is said to be completely silent. Its leaps from tree to tree are described as of tremendous length. It subsists mainly on various kinds of wild fruits, seeds, and insects, and retires to sleep high up in the trees. In Gojam it is hunted for the sake of its fur, which is used for covering the shields of Abyssinian soldiers.

These black-and-white guerezas illustrate the evolution of a remarkable type of colouring. Starting from the wholly black species a gradual transition can be traced to one in which the sides of the face, flanks, and hindquarters, together with nearly the whole of the tail, are furnished with long fringes of pure white hairs, apparently developed to accord with the pendent white lichens clotting the branches of the boughs among which these monkeys dwell.

THE BLACK GUEREZA

In marked contrast to the pied colouring of the preceding species is the sable hue of the black guereza (*C. satanas*), first described from specimens obtained at Fernando Po, on the West Coast of Africa, in 1838. The uniform black suffices to distinguish it at once from all its congeners. In addition to this black colouring, the crown of the head has a crest of long hair projecting over the temples and eyes, and the whiskers are long and expanded. The whole of the body is covered with long and rather coarse hair; but the tail is short-haired throughout the greater part of its length, and has no trace of a tuft at the end. The whole of the hair has a dull and shaggy appearance, recalling that of the sloth bear of India. The length of the head and body is 32 in., that of the tail 40 in.

THE KING GUEREZA

The king monkey (*C. polycomus*) of Sierra Leone is one of the few guerezas that have been exhibited alive in the Gardens of the London Zoological Society. It has no crest on the head, but a long mane on the throat and chest; the hair of the sides of the body



THE WHITE-THIGHED GUEREZA

being likewise long. The general colour is black, but the mane, the forehead, and the sides of the face, as well as the whole of the tail, are dazzling white. The tail has a well-marked tuft at the end; and the entire coat of hair is very glossy.

THE URSINE GUEREZA

Closely allied to the last species is the so-called ursine guereza (*C. ursinus*), from Fernando Po, in which the mane is greyish, and not longer than the hair on the sides of the body. Another nearly related West African monkey is the Angola guereza (*C. angolensis*), which differs from the king guereza in that the chest and two-thirds of the lower portion of the tail are black (page 220).

THE WHITE-THIGHED GUEREZA

More markedly distinct than the preceding from the king guereza is the white-thighed guereza (*C. vellerossus*) of Western Africa, distinguished by the absence of a mane on the head and throat, although it has a large fringe round the face. The general colour is glossy black; but that of the forehead, of the frill round the face, and on the chin is white. The tail is also white; but the most distinctive characteristic of the species is the silvery white of the thighs, from which it derives its name. The haunches are, moreover, generally grey. The white hair of the thighs is shorter than that on the body.

THE BAY GUEREZA

Very different in colouring from any of the species yet mentioned is the bay guereza (*C. ferrugineus*), known from the Gambia and the Gold Coast, from which a specimen was brought alive to England in 1890, but did not long survive its arrival. This handsome species has comparatively short hair, which, on the crown of the head and the back and upper part of the sides is blackish grey, while the cheeks and throat, as well as the under parts and the limbs, are of a rich ferruginous bay. The upper part of the root of the tail is blackish, and the remainder reddish brown. The ears and the greater part of the face are bluish, but the nose and lips are flesh-coloured. Altogether the bay guereza is a striking species, which, once seen, will always be easily recognised.

THE CRESTED GUEREZA

The last of the guereza monkeys to be noticed is the crested guereza (*C. cristatus*), which is likewise a West African species, distinguished by its short yellowish brown fur, which becomes greyer on the front of the body; the shoulders and outer sides of the arms, the throat, chest, under parts, and inner sides of the limbs being greyish white. It differs from all the other species in that the hair on the forehead radiates from two points on the temples, and in having a low erect crest of longer hairs running along the middle line of the head.

THE GUENON MONKEYS

In systematic zoology such of the Old World monkeys as have no cheek pouches, but possess sacculated stomachs, and in which the legs are longer than the arms, constitute the subfamily Colobinae of the family Cercopithecidae. There remain for consideration all the other Old World monkeys, together with the baboons, which, although belonging to the same great family, constitute the large separate subfamily of the Cercopithecinae. This group is characterised by the circumstance that all its members are furnished with cheek pouches, but their stomachs are simple, and the arms and legs of nearly the same length.

Since there is no English name to distinguish this group of African monkeys from others of the same family, it will be found convenient to use the French name guenon, meaning "one who grimaces," which appears to have been especially applied to the monkeys of this group, as being those most familiar in menageries and shows.

As already mentioned, these monkeys are strictly confined to Africa, where they are represented by a great number of species, of which a large proportion is found on the western side of the continent. None is of large size, and they all present

the following features by which they are characterised as a genus (*Cercopithecus*).

In build they are comparatively slender, and their muzzle is short, or, at least, not very long. The tail is invariably long and slender, and the naked callosities on the buttocks are of small size. For another important point of distinction recourse must be had to the dried skulls, an examination of which will show that the last molar, or wisdom tooth, on each side of the lower jaw consists of four tubercles only, and of these the front and hind pairs

are connected by a pair of transverse ridges. In this respect the guenons differ, not only from the langurs and guerezas, but from all those to be subsequently noticed, in which the last lower molar has a fifth tubercle forming a kind of heel projecting from behind the second transverse ridge.

In general appearance, more especially as regards their slender build and long tails, the guenons are the members of the present subfamily which make the nearest approach to the langurs and their allies. Like most of the African monkeys

to be noticed later, they are characterised by having each hair marked by a series of different-coloured rings, which imparts to the fur a peculiar mottled appearance.

In disposition these monkeys are docile and easily taught, and so well do they thrive in captivity that it is not uncommon for them to breed in menageries. In consequence of this docile disposition, and their comparatively hardy constitution, as well as from the facility with which they learn tricks and obey the word of command, it is these monkeys, or the members of the next genus (the mangabeys), which are generally chosen as companions by organ-grinders. "Mischievous as a monkey" is truer of the guenons than of any other members of the order, and it is largely to them that the monkey-house at the Zoological Society's Gardens in London owes its popularity.

In saying that the guenons are docile, it should be added that they are teachable for monkeys, since in the strict sense of the word all monkeys are far less docile and less susceptible of education than many other mammals. This, however, by no means implies that monkeys have not a very high degree of intelligence. In regard to this point the following paragraph from the writings of Dr. W. T. Blanford may be quoted: "It is the commonest mistake among superficial observers, and even among naturalists, to confound docility and intelligence among animals, and to measure their intellectual powers by the facility with which they can be taught. Hence the very common, but, as it appears to me, very incorrect notion, that



HEAD OF THE ANGOLA GUEREZA

Photograph by W. P. Dando

THE GUENON MONKEYS

monkeys are of inferior intelligence to such animals as dogs and elephants. In reality they are less docile, less willing to learn, and less adapted to captivity; moreover, being of but little use to man, far less trouble has been taken in studying their habits. Thus, while dog and elephant breaking engage all the time and mental resources of particular classes of men, the instruction of monkeys is left to the unaided efforts of amateurs and organ-grinders. The negro race among men appears to be far better adapted for slavery than most savage races, being more docile in a state of captivity; but it is scarcely proved to be more intelligent on that account. The same reasoning will, doubtless, apply to animals. I have often seen dogs and monkeys kept together, and in every instance it has appeared to me that the monkey ruled the dog, and that the dog, although the more powerful animal, feared the monkey; and I can only account for this by the superior intelligence of the monkey."

In their native condition guenons associate in separate families or droves, each under the leadership of an old male. And it appears that each drove has its own particular limits of territory beyond which it cannot go without intruding on the domains of another drove, an invasion which is treated at once as a *casus belli*. Indeed, this principle of territorial rights appears to be so deeply implanted in guenon nature that it persists even in captivity, when it is not uncommon to see two or more of these creatures zealously guarding one portion of the cage from all intruders.

As they were the common monkeys of Africa, the guenons were well known to the ancient Egyptians, and it is probable that most of the long-tailed monkeys we see on old sculptures are either guenons or mangabeys. Not only were the guenons familiar to the Egyptians, but they appear to have been imported into classic Greece and Rome; and it is believed that the Greek and Latin term *Cebus* was used to designate them, although this name is now applied to a South American group, the sapajous, or capuchins.

THE MALBROUCK MONKEY

The malbrouck monkey (*Cercopithecus cynosurus*) of Western Africa may be taken as the first representative of a group of guenons characterised by their oval heads and somewhat long muzzles, as well as by their stiff and backwardly-directed whiskers. The fur is grizzled, each hair being marked with greenish or reddish rings.

The malbrouck is distinguished from the other members of this group by the large and broad face being flesh-coloured. The general hue of the

fur is yellow, grizzled with black; a distinct band on the forehead, as well as the whiskers, throat, the under parts, and the inner surface of the limbs being whitish. The first specimen exhibited alive in England had an unusually mild and gentle expression of countenance, and was calm, circumspect, and inactive in its habits. It did not, however, appear anxious to encourage familiarity on the part either of its keepers or of strangers, and was always ready to resent any interference with its liberty

THE VERVET MONKEY

Still better known than the malbrouck is the South African vervet monkey, or black-chinned vervet (*C. pygerythrus*), as it has been called, in which, as in all the other members of this group, the rather small and narrow face is entirely black or blackish.

The fur of the vervet is of a greyish green colour, finely speckled with black on the greater part of the body. The face, hands, and feet, and the terminal third of the tail, are of a deep black; while the cheek, throat, and under parts of the body are reddish white, and the root of the tail and adjacent regions are red. The white band on the forehead is distinct. The red root and black tip of the tail, which has no basal tuft, and chin are absolutely distinctive of this species.

In size the vervet is somewhat smaller than the mona. It is common in forest districts throughout Cape Colony and adjacent regions, more particularly along the tract of coast extending from Cape Town to Algoa Bay, and thence through Kaffraria and Natal. It is said to feed chiefly on gum from the acacias known as camel-doorn and rhinaster-bosh; and its habits are like those of the green monkey.

The Mozambique monkey (*C. pygerythrus rufoviridis*), from the Mozambique and Zambesi districts, is a local race of the vervet, with which it agrees in having the root of the tail and adjacent regions of a ferruginous red, but differs in the more yellowish grey tint of the fur of the upper parts, which tends to a blacker hue on the crown of the head, the tail, and the outer sides of the limbs; while the under parts and the inner sides of the limbs are pure white, instead of reddish white.

THE GRIVET MONKEY

The grivet (*C. æthiops*) is a member of the group inhabiting North-Eastern Africa, inclusive of the Upper Nile districts, Abyssinia, Senar, and Kordofan.

The fur is olive green, speckled with yellow and black, while the chin, whiskers, and under parts of the body are white, and the root of the tail and adjacent regions grey. The forehead has a broad whitish band, more or less strongly marked; and the face is black. The white chin and grey root to the



THE VERVET MONKEY

tail serve to distinguish this monkey from the vervet, with which it agrees in size. Writing of grivets in Abyssinia, Blanford says they are rarely seen, and then only in forests. "On the highlands I only once saw a flock—this was near Dildi, south of Lake Ashangi. I met with large numbers on the Anseba, where they inhabited the high trees on the banks of the stream. The flocks seen were small, not exceeding twenty to thirty individuals. I had but few opportunities of observing their habits, but they appeared to differ but little from those of macaques, except that the former is a quieter animal and less mischievous. In captivity they are well known as excessively docile and good-tempered, and fairly intelligent."

BLACK-BROWED GREEN MONKEY

One of the commonest of the guenons in menageries is the West African green monkey (*C. sabæus*), in which the colour of the fur is a mixture of black and yellow, giving a general dark green hue to the upper parts; the crown of the head, the hands, feet, and the upper part of the root of the tail being blacker. There is no distinct light band on the forehead, and if this be represented at all, it is very narrow. The whiskers, throat, and the under side and end of the tail are yellowish, sometimes tending to orange; and as in the grivet, the base of the root of the tail is grey (see page 160).

This green monkey is closely allied to the grivet, from which it may be distinguished by the more yellow-green hue of its upper parts, the yellowish whiskers, and the absence of a distinct white band on the forehead. It is about the size of a large cat, the length of the head and body being 16 or 18 inches, and that of the tail rather more. It is one of the hardest of the guenons, on which account it is frequently seen in confinement, as it bears the English climate well. Although gay and gentle during youth, it usually becomes morose and vicious when old, and is therefore not one of the species usually selected for exhibition by organ-grinders. Like the other members of the group, the green monkey never utters a sound when in captivity, and from an early account of the species it appears to be similarly silent in its wild condition.

Senegambia, Sierra Leone, and Liberia, are the home of this species. In Nigeria it is represented by the white-browed green monkey (*C. tantalus*), which has a similar black face, but a conspicuous white brow-band.

THE PATAS MONKEY

The patas, or red monkey (*C. patas*), of Senegambia, is a large, long-legged monkey, differing from all the other members of this group yet noticed in the red colour of the fur of the greater part of the body, the whitish lower portions of the limbs, and the pink-coloured ears and face; the nose, an arched band on the forehead, and the outer surfaces of the arms being blackish. In addition to these leading features, it may be mentioned that beneath the large ears there are thick bushy tufts of light grey hair, which extend forwards on to the cheeks and lower jaw, so as to cause the naked part of the face

to be limited to a narrow space between the eyes and the upper lip. From these tufts the greyish-coloured hair is continued on the whole of the under surface of the body, as well as on the inner sides of the limbs. The hands are of a dusky brown colour, with very short fingers, and the thumb is reduced almost to the condition of a tubercle. The black of the nose continuing upwards to the arched band of the same colour above the eyes communicates a very peculiar and characteristic physiognomy to the patas, which led Buffon to describe it as the monkey *à bandeau noir*.

On the opposite side of Africa, in Nubia and Somaliland, the place of the patas is taken by a closely allied monkey, known as the nisnas, which may best be regarded as a local race of the patas, under the name of *C. patas pyrrhonotus*. The nisnas is distinguished from the typical patas by the nose of the adult being white instead of black, and by the red colour of the body being continued on to the shoulders and the outer sides of the arms, instead of these parts assuming a blackish tinge. The nisnas is the monkey so frequently represented on the ancient Egyptian monuments; and it appears to be undoubtedly the cebus of the ancients, which, on the authority of Pythagoras, was described by Ælian as inhabiting the Red Sea littoral, and was said to be of a bright flame colour, with whitish whiskers and under parts.

Other races of the patas inhabit North Central Africa, and thus connect the habitat of the typical patas with that of the nisnas. These monkeys are believed to be inhabitants of open country instead of forests, which accounts for their peculiar and distinctive type of colouring.

SYKES'S MONKEY

This East African monkey (*C. albogularis*) is the type of a group of some eight species of large guenons allied to the black-bellied monkey, but distinguished by the smaller amount of black in the colouring. The head, nape, shoulders, and cheeks are very uniformly coloured, generally speckled yellowish grey and black; and the back is usually reddish or yellowish. The present species is distinguished by the pure white colour of the under parts and chest, which extends on to the throat, and thus suggests the scientific name. This monkey was originally brought to England by Colonel William Henry Sykes, afterwards M.P. for Aberdeen, by whom it was described in 1831. Its describer stated that its manners were grave and sedate; its disposition was gentle, but not affectionate; free from that capricious petulance and mischievous irascibility which characterise so many of the African species, but yet resenting irritating treatment, and evincing its resentment by very sharp blows with its hands. Other members of this group are *C. kolbi*, from the Keelong Escarpment; *C. molonyi*, of Nyasaland; and *C. stairsi*, of Zambezia.

THE BLACK-BELLIED MONKEY

The black-bellied Pluto monkey (*C. leucampyx*) is a West African species, representing a group characterised by the prevalence of black on the head,

CHARACTERISTIC SPECIES OF THE GUENON MONKEYS



Malbrouck Monkey



Gallet Monkey



Moustache Monkey



Young Nimias Monkey



Patas Monkey



Green Monkey



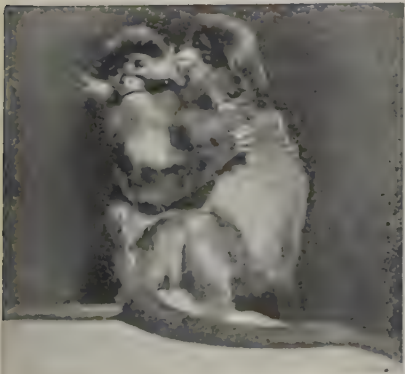
Mona Monkey



Haplorhina Monkey



Sykes's Monkey



Schmidt's and Red-eared Monkeys



Moustache Monkey



Burnett's Monkey

Photographs by L. Medland, W. P. Dando, W. S. Berridge, H. Irving, and others

nape, shoulder, belly, and thighs. When the head is strongly speckled, the belly and thighs are black; and when the two latter are speckled, the head, except for the light brow-band, is black. The black-bellied species has no beard, but large bushy whiskers. The colour of the fur is black, finely grizzled with grey; the forehead has a whitish band, and the sides of the forehead, as well as the shoulders, chest, tail, and limbs, are entirely black, with no white on the haunches. The range of this monkey extends from West to East Africa, the eastern races including *C. leucampyx stuhlmanni*, of the district of the great lakes, and *C. l. carruthersi* from Mount Ruwenzori. The other members of the group are *C. opisthostictus*, of the Lake Mweru district, and *C. kandi*, from the neighbourhood of Lake Kivu.

THE MONA MONKEY

One of the most familiar of all the guenons is the mona monkey (*C. mona*), a beautiful little creature which may be recognised by the presence of a large and distinct white spot of an oval shape situated on each hip immediately in front of the root of the tail, this feature being peculiar to the species.

The mona, which is a West African monkey, has no real title to its name, which is merely the Moorish word for monkeys in general. The general hue of the fur is blackish olive, finely grizzled with yellow; this gradually darkens towards the hind part of the body, so that the tail and the outer surfaces of the limbs are nearly black. The under surface of the body is nearly pure white, these white parts being separated from the darker regions by an abrupt division; and there is also the distinctive white spot on each side near the root of the tail. The naked portions of the face are purplish, with the exception of the lips and chin, which are flesh-coloured. The bushy whiskers, which come forward so as to conceal a large part of the cheeks, are straw-coloured, with a mixture of a few black hairs. A black transverse band, surmounted by a thin streak of grey, extends from above the eyebrows to the base of the ears; the latter, together with the hands and feet, being of a livid flesh-tint.

The mona is the typical representative of a group of guenons collectively characterised by the following features. The pale colour of the inner surface of the arms forms a marked contrast with the black or dark grey tint of the outer side. A black band extends from ear to ear across the temple, sharply sundering the colour of the cheeks from that of the crown of the head. There is also a well-defined pale brow-band, which sometimes extends over a considerable portion of the summit of the head. In colour the face is slaty blue, but the middle of the lips is flesh-coloured. The shoulder and the fore portion of the back are redder or greyer than the posterior area, which tends to blackness.

There are rather more than half a dozen species in this group, of which the collective range extends from the West Coast through the Equatorial forest-zone to the Ituri forest of East Central Africa.

Among the members of the group is the bearded

guenon (*C. pogonias*), which has the fur of the upper parts either greyish or olive brown, finely grizzled with grey or yellow. From above the eyes to the ears there is a black streak, while there is also a stripe of the same hue down the back; and the hands and feet, as well as the tail, are likewise black. The forehead, the whiskers, the small moustache, and the under parts of the body and the inner sides of the limbs are yellowish. This species has been obtained from Fernando Po and the Gabun.

This bearded monkey and the nearly allied Erxleben's monkey (*C. grayi*) represent a subgroup characterised by their yellowish or rufous ear-tufts and the presence of three longitudinal black stripes on the forehead.

Another member of the mona group is the West African Wolf's monkey (*C. wolfi*), which has light under parts, and differs from the other species in the ferruginous colour of the legs, as well as in the yellowish white bar across the forehead, and in the red on the inner sides of the arms, thighs, and belly being pronounced only when the white passes into the coloured outer or lateral surface.

All the above-mentioned members of the present group, with the exception of the mona itself, have a rusty yellow tinge on at least the borders of the under surface of the body, and also on the hairs of the ears. In the mona and three other closely related species the whole under surface and the under sides of the limbs are white, while the hair on the ears is generally speckled.

Campbell's guenon (*C. campbelli*), which is one of the commonest West African monkeys, is one of these three immediate relatives of the mona, all of which lack the white spot on the thigh near the root of the tail. Campbell's guenon, which is found in troops and is stated to take readily to water, is characterised by having the basal two-thirds of the tail yellowish grey, and a white brow-patch. Burnett's guenon (*C. burnetti*), of the African West Coast, differs by the yellow brow-patch, which is nearly obsolete in Dent's guenon (*C. denti*), of the Ituri forest.

THE MOUSTACHE MONKEY

In all the round-headed and short-muzzled guenons mentioned above the nose and body are of the same colour. There are, however, other groups of guenons in which the nose usually has a spot or patch of white, red, or blue. Most of the members of these groups are West African, but they are also to be found in Eastern Equatorial Africa. The leading characters of the moustache monkey (*C. cephus*) are a triangular blue mark on the nose, and yellow whiskers. Its colour is olive green, speckled with yellow, the throat and under parts being grey, the face and temples black, and the feet and hands blackish. The members of the moustache group resemble the lesser white-nosed monkey in the almost uniformly speckled colouring of the head, back, and sides of the body, and usually in the presence of a dark brow-band extending backwards to the ears, and of a second black stripe separated from the former by a patch of yellowish hair running

THE GUENON MONKEYS

from the neighbourhood of the upper lip for a variable distance towards the lower rim of the ear, but having the throat and under parts, and at least the upper portion of the inner surface of the limbs, dark, ashy grey, instead of white or greyish white. All the members of the *cephus* group are West African. In addition to the type species, they include *C. erythrotis*, of Fernando Po and the Cameroons, and *C. sclateri*, of Benin.

THE HOCHOUR MONKEY

The hochour monkey (*C. nictitans*) is one of two species belonging to the group of guenons known as white-nosed monkeys, from the circumstance that the nose in all of them is covered with white hairs. This particular species is distinguished by the blackness of the fur on the upper and lower surfaces of the body, that of the back being finely speckled with yellow. The naked part of the face is of a bluish black colour; the upper eyelids are flesh-coloured, and the hands and feet jet black. It inhabits the Cameroons and neighbouring districts, and may be distinguished from its relative, *C. martini*, ranging from Liberia to the Cameroons, by the under parts and inside of the arms being blackish instead of whitish. The hochour, sometimes known as the larger white-nosed monkey, may be distinguished from the lesser white-nosed monkey not only by its superior size, but also by its more prominent nose. It has been described as lively and good-natured, but not so gentle and familiar as the next species, and more resembling in its temper and general character the mona monkey.

THE LESSER WHITE-NOSED MONKEY

This elegant monkey (*C. petaurista*), which comes from the West Coast of Africa, is one of the smallest of the guenons. It was described in the works of Buffon under the well-chosen name of blanc-nez, and is distinguished from the hochour by its smaller size and the flatness of its nose, as well as by the lighter tint of the under parts. In colour, the fur of the back is olive green, speckled with yellow;



THE HOCHOUR MONKEY
Photograph by W. S. Berridge

the face black; the white spot on the nose small and nearly triangular; and the cheeks, chin, under parts of the body, the inner sides of the limbs, and the under side of the tail are white. It represents a small group, which includes *C. ascanius*, of the Congo, with a local race, *C. a. schmidtii*, in Uganda, and the West African *C. signatus*.

The following account of the habits of the lesser white-nosed monkey in confinement is taken from an anonymous writer, who states that its manners "are playful and engaging beyond any other species we have ever observed, and it has an amiability and innocence in its conduct and expression which, united to its lively and familiar disposition, never fail to make it a prime favourite with its visitors. An individual of this species, which formerly lived in the gardens of the London Zoological Society, was confined in the same cage with a young hanumán, whose gravity was sorely disturbed by the unwearied activity and playfulness of its mercurial companion. Whilst the white-nose was frolicking round the cage or playing with the spectators, the hanumán would sit upon the perch, the very picture of melancholy and apathy, with his long tail hanging down to the bottom; but his attention was roused and his security endangered every moment by the tricks of the restless little creature, which in its sports and gambols continually caught the hanumán's tail, either to swing itself out of the reach of the spectators, or, like a boy at his gymnastic exercises, to assist it in climbing up to the perch. All this, however, was done, with great good-nature on both sides, and it was highly diverting to see the playful innocence of the one and the gravity with which the other regarded it, like a parent enjoying the follies of a child."

THE DIANA MONKEY

The well-known Diana monkey (*C. diana*), which derives its name from the white crescent on the forehead above the eyebrows, typifies a group of two West African species characterised by the longer or shorter white beard, the white streak on the haunches near the root of the tail being also distinctive.



THE ROLLOWAY MONKEY
Photograph by W. S. Berridge

The general colour of the fur is black, finely speckled with white, thus producing a greyish grizzle. In addition to the white beard and the crescent on the forehead, the cheeks, chin, throat, chest, front of the shoulders, as well as the inside of the thighs and the streak across the haunches, are likewise white. On the other hand, there is a broad streak of a bay colour down the back, and the same tint also prevails on the rump. The face, tail, and the outer sides of the wrists and legs are black, as well as the hands and feet. All the colours are sharply defined from one another; and the long, narrow, black face, terminating below in the white beard, and surmounted by the crescent above the eyebrows, gives it a peculiar and characteristic expression. The whole length of the head and body is about 18 in., while the length of the tail reaches to some 24 in.

In the Diana monkey the beard is relatively short, with its basal portion covered to a considerable extent by black hairs; but in the rollaway (*C. rollaway*) it is much larger, and wholly white (page 225). The former species is confined to Liberia, while the latter ranges from the Gold Coast to Guinea.

THE MANGABEYS

The typical mangabeys, or, as they are often called, white-eyelid monkeys, comprise a small group of West African species, which, while agreeing in general characters with the guenons, are distinguished by the presence of a projecting heel at the hind end of the last molar tooth on each side of the lower jaw, so that the crown of this tooth carries five, in place of four, tubercles. In this respect the mangabeys agree with the great group of macaques, and on this ground these monkeys have been separated from the guenons to form a distinct genus under the name of *Cercocebus*.

The name mangabey, it may be observed, is taken from the district Mangabe, or Manongabe, in Madagascar, and was applied by Buffon to these monkeys from the mistaken idea that they came from that island, which in his time appears to have been a kind of refuge for the destitute in regard to animals whose habitat was unknown. In spite, however, of this totally erroneous origin, the name is a convenient one, and has been almost universally adopted for this group.

In respect of general characteristics it may be said that the typical mangabeys have an oval-shaped head, with a somewhat long muzzle; and that they may be readily recognised in the living condition by the flesh-coloured eyelids, and by the circumstance that their hairs differ from those of the guenons in not being tinged with different colours.

THE SOOTY MANGABEY

This monkey belongs to a small group characterised by the hair of the crown of the head being directed backwards, without any prolongation into a crest. As its name implies, the fur of the sooty mangabey (*Cercocebus fuliginosus*) is of a deep and dull black hue; the chin and under parts being ashy. The face is livid, marked with dark brown blotches about the eyes, nose, muzzle, and cheeks; the ears, as well as the palms of the hands and the soles of the feet, being of a blacker brown.

At least in captivity, this species is characterised by the unusual habit of keeping its long tail turned forwards over the body. In confinement this mangabey is docile and good-tempered, and more amenable to instruction than is the case with the majority of the larger guenons. A specimen which lived many years ago in the Zoological Society's Gardens in London was a most importunate beggar; but instead of snatching in the customary simian fashion the contributions of his visitors with violence or anger, he solicited them, and, of course, obtained them the more readily, by tumbling, dancing, and a hundred other entertaining tricks. He was very fond of being caressed, and used to examine the hands of his patrons with remarkable gentleness and gravity, trying to pick out the tiny hairs, expressing satisfaction during the process by smacking his lips and uttering a low, surprised grunt.

The white-collared mangabey (*C. collaris*) may be easily distinguished from the sooty mangabey by its blackish grey colour, the white round the neck, and the bay on the crown of the head; the white of the collar extending on to the cheeks, throat, and chest (page 227).

A third representative of this group is the white-crowned mangabey (*C. lunulatus*), which takes its name from a characteristic white spot on the crown, and is also distinguished by a white streak running down the middle of the back.

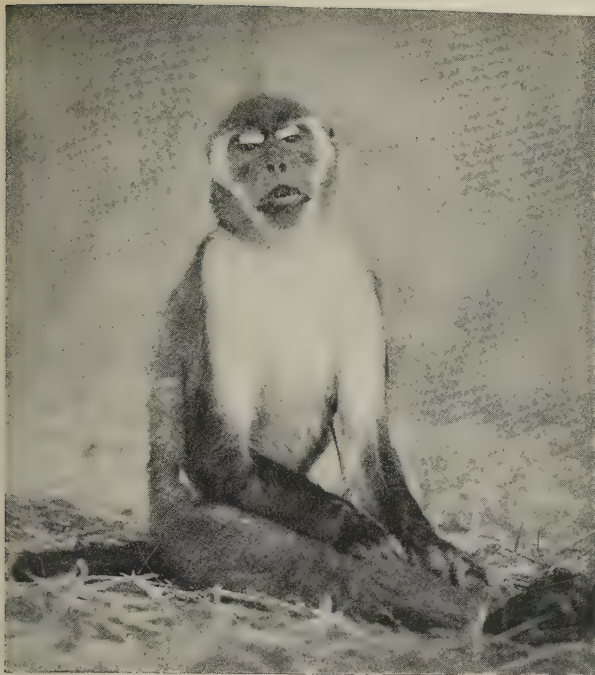
THE CRESTED MANGABEY

The fact that the hair of the crown of the head is lengthened so as to form a crest affords a ready means of distinguishing the crested mangabey (*C. albigena*) from the true mangabeys; a further distinction being the black upper eyelids (page 227). The colour is blackish, but the creature's name is founded on the greyish hairs on the sides of the throat and cheeks. It was first made known to science in 1850 from specimens sent home to England from the West Coast of Africa by Du Chaillu before his celebrated expedition of 1856. Since that date several local races have been distinguished, one of which (*S. albigena johnstoni*) is from the Tanganyika district; while



THE SOOTY MANGABEY
Photograph by W. P. Dando

THE MACAQUE MONKEYS



THE WHITE-COLLARED MANGABEY
Photograph by W. P. Dando

C. albigena rothschildi is probably from the Congo. Some naturalists consider that these monkeys should be separated from the typical mangabeys under the name of *Semnocebus*.

THE ORANGE-BELLIED MONKEY

This remarkable West African monkey (*C. chrysogaster*), probably from the Congo, appears to connect in some degree the guenons with the mangabeys. Having brilliant orange under parts, this monkey resembles the guenons in the differently-coloured rings on the hairs of the crown of the head and back, but agrees with the mangabeys in the flesh-coloured upper eyelids.

HAGENBECK'S MONKEY

Another interesting West African species, likewise probably from the Congo, is Hagenbeck's monkey (*C. hagenbecki*), in which the hair of the crown of the head and neck is ringed with black and yellow, like that of the guenons, but that on the back uniformly yellowish grey, as in the mangabeys. In the male the upper eyelids are dark, although in the presumed female they are of the flesh-coloured type characteristic of the typical mangabeys.

THE MACAQUE MONKEYS

Reference has already been made to the curious origin of the term mangabey, and it appears from the sequel that there is a kind of fatality in regard to the misapplication of names among these animals. So far as can be learnt, the name macac, or macaque, seems to be a barbarous word which, in Marcgraves' "Natural History of Brazil," published in the year 1648, is given as the native name of a monkey from the Congo and Guinea. Buffon, however, with the facility for misappropriation for which he was

notorious, transferred this name to the Indian group forming this part of our subject, and to them it has ever afterwards clung, having been Latinised into *Macacus*. In spite of its origin, the name is good enough, and so must remain.

In the account of the mangabeys it was shown that these monkeys differ from the guenons in having a heel, and thus five cusps, to each of their last lower molar teeth, and frequently also in the uniform colouring of the individual hairs (page 226). As this is also the case in the macaques, it is obvious that in this respect the mangabeys form a transition to them from the guenons; and it is now desirable to point out how the macaques and mangabeys are distinguished from one another.

In the first place, macaques are always of stouter build than mangabeys; and secondly, they are characterised by the considerably greater prolongation of the muzzle and the larger size of the naked callosities on the buttocks. In some macaques the tails are as long as those of the guenons and mangabeys; in others these appendages are very short, while in few they are actually wanting; thus showing that the presence or absence of a tail is of no import either as a generic character, or as indicative of a higher or lower degree of organisation. In common with those of all the monkeys hitherto considered, the nostrils of the macaques do not reach as far forwards as the extremity of the muzzle.

From these characters it will be apparent that while the macaques are sufficiently distinguished from the mangabeys to be entitled to rank as a separate genus, yet both groups are closely allied. In the opposite direction the macaques are intimately connected through one singular intermediate form with the baboons of Africa, so that an almost complete transition exists from the guenons through the mangabeys to the macaques, and thus to the baboons.



THE CRESTED, OR GREY-CHEEKED MANGABEY
Photograph by W. S. Berridge

In speaking of the macaques as Asiatic monkeys, it should be mentioned that one solitary outlying species is found in the mountains of North-west Africa, and also on the opposite coast of Gibraltar. The great majority of the species, however, are confined to India, Burma, the Malay Peninsula, and the islands of Borneo, Sumatra, etc. Some range as far east as China, and one is found even in Japan. To the north, macaques extend into the outer ranges of the Himalaya Mountains, while a single species inhabits the secluded highlands of North-western China.

The whole of the monkeys reckoned as macaques seem to have much the same general habits, being always found gathered together in troops, which may include considerable numbers, and always comprise individuals of both sexes, and of all sizes and ages. They are forest-dwelling animals, and, while active and rapid in their movements, are less markedly so than their compatriots the langurs. As regards food, macaques have a varied appetite, most, if not all, eagerly eating insects as well as seeds and fruits. Moreover, they have occasionally been observed to devour lizards, and it is reported that frogs also form part of their food on rare occasions; while one species is known to subsist partly on crustaceans. Their cheek pouches are of very large size, and it is the general habit of these monkeys to stuff these receptacles as full as they will hold on every available opportunity.

The voice and gestures of all the macaques are similar, and differ markedly from those of the langurs. According to Colonel Tickell—an excellent observer of the habits of Indian animals—"Anger is generally silent, or, at most, expressed by a low, hoarse 'heu,' not so gular or guttural as a growl. Ennui and a desire for company are rendered by a whining 'homi'; invitation, deprecation, entreaty, by a smacking of the lips and a display of the incisors into a regular broad grin, accompanied with a subdued grunting chuckle, highly expressive, but not to be rendered on paper. Fear and alarm are indicated by a loud, harsh shriek, 'kra,' or 'kraouk,' which serves also as a warning to the others who may be heedless of danger. Unlike the langurs and gibbons, they have no voice of call to one another."

Most of the species are docile if caught young, but old males that have been captured when fully grown are sometimes exceedingly spiteful; and I have a very vivid recollection of a pig-tailed macaque formerly in the Zoological Gardens at Calcutta

that was very ferocious, and would fly, with open mouth and the most menacing gestures, at every visitor who approached his cage. In their wild state it also appears that they will occasionally show fight. Mr. R. A. Sterndale states, for instance, that on one occasion during the Indian Mutiny he came across a party of rhesus macaques, among which there were several females with young ones. He endeavoured, without success, to run them down in order to capture the latter, when he was deliberately charged by the old males of the party, the leader of which he had to despatch with a pistol bullet. Several of the species will breed in captivity. As a rule, their manners under restraint are the reverse of pleasant.



THE BONNET
MONKEY

THE BONNET MONKEY

One of the best known of the longer-tailed macaques is the South Indian bonnet monkey (*Macacus sinicus*), which is one of two closely allied species characterised by the fact that the hair of the crown of the head is lengthened and arranged in a radiating manner from the middle line, and by the large ears.

This species takes its name from the crest of hair on the crown, which, instead of coming over the forehead, as a rule stops short of that part of the head, and thus assumes a toque-like form (page 212). On the forehead the short hair is usually parted down the middle line. The fur, which is of moderate length, straight and smooth, is brown or greyish brown above, and pale brown or whitish on the under parts. The face and ears are flesh-coloured, and in some examples the ends of the hairs are ringed. The tail is generally nearly or quite as long as the head and body, the length of the two latter being about 20 in.

This macaque, which occurs all over Southern India and extends westwards to Bombay, is the common monkey of those regions, being found not only in the forests, but likewise in the towns, where it pillages the shops of the *bhantias*, or native grain-sellers. It is exceedingly mischievous, and a ready mimic, although the rhesus monkey is its equal in these respects.

In Ceylon this monkey is replaced by the closely allied toque monkey (*M. pileatus*), which appears only to differ in colour, although the long hair of the crest of the head seems to be more generally continued on to the forehead.

Among the Sinhalese this monkey is known as the rilawa. Sir Emerson Tennent speaks of it as the

THE MACAQUE MONKEYS

universal pet and favourite of natives and Europeans alike, the Tamil conjurers teaching it to dance and carrying it from village to village, clad in a grotesque dress, to exhibit its lively performances. After all, the mimicry and amusing tricks of a monkey in captivity are a mere shadow of what they are in its native forests, so that persons who have only seen these animals in confinement have but a faint idea of their faculty for fun.

THE CRAB-EATING MACAQUE

This species derives its name (*M. cynomolgus*) from its habit of feeding on crabs from the brackish waters of the lagoons and swamps on the coast. It is the true macaque of Buffon, and is known to the Malays, apparently from its cry, as the kra.

It may be at once distinguished from the bonnet monkey by the circumstance that the hair on the crown of the head is neither longer than the rest nor distinctly radiated from the middle. In some individuals there is, however, a trace of a crest, with slight radiation of the hair from one or more points on the forehead. As a rule, the general colour of the fur of the upper parts varies from a dusky or greyish brown to rufous or golden brown; the under parts being either light greyish brown or nearly white. The hairs of adult individuals vary in colour in different parts of their length, and are ringed at their tips. The naked parts of the face and the callosities on the buttocks are flesh-coloured or dusky. The eyelids are either white or bluish white. The tail is nearly as long as the head and body, the combined length of the two reaching 22 in.

In the dark and smaller variety of this common monkey the fur is dusky; while in the lighter or golden rufous variety the face is flesh-colour.

The range of the crab-eating macaque is a very wide one, extending from Siam in the east, through the Malay Peninsula into Lower Burma and the Arakan coast. It is also found in the Nicobar Islands in the Bay of Bengal, although it has probably been introduced there by human agency. Local races inhabit many of the Malay islands.

What induced the ancestors of this monkey to forsake the usual simian food and take to a diet of crabs and insects is difficult to conceive; unless, indeed, they may have been driven to it during a season of scarcity, and found it so much to their

liking that they have continued it ever since. Be this as it may, however, there is no doubt whatever as to the crustacean-devouring proclivities of this species. Besides stating that they frequent the banks of salt-water creeks and devour shellfish, Sir Arthur Phayre says that in the cheek-pouches

of a female were found the claws and body of a crab. There is not much on record regarding the habits of this creature in a wild state beyond what is stated concerning its partiality for crabs, a *penchant* which Sir Arthur believes to be shared by the rhesus in the Bengal Sundarbans. Crab-eating macaques are common on the tidal creeks and rivers of Burma and Tenasserim, especially in the delta of the Irawadi. They go usually in small family parties of from five to fifteen, including an old male and four or five females with their offspring. Their home is among the roots and boughs of the mangrove trees, and they spend a large portion of their time in searching for insects and crabs. From the constant presence of human beings on the waterways near which they

dwell, these monkeys become very tame, and can be easily approached. They will even pick up rice or fruit thrown down to them. Still more remarkable is the facility with which they can swim and dive. On one occasion a male of this species that had been wounded and placed for security in a boat jumped overboard and dived several times over to a

distance of some fifty yards in order to prevent recapture. Like most macaques, this species is gentle if captured at a sufficiently early age, but the old males always become fierce and morose. On account of its white eyelids, care must be taken not to confound this monkey with the mangabeys, noticed previously (page 226).

THE LION-TAILED MONKEY

The lion-tailed monkey (*M. silenus*) of Western India is the first of the macaques in which the length of the tail is less than three-quarters of that of the head and body taken together. It is often called the wanderu—a term which, how-

ever, should be restricted to the langurs of Ceylon—and may be distinguished from all the other species by its general black colour, and the enormous grey beard and ruff which surround the black face (page 212), with the exception of the middle of the forehead, where the ruff stops short. The fur is long, and the slender tail, which is tufted at its



THE RHESUS MONKEY



YOUNG CRAB-EATING MACAQUE
Photograph by W. P. Dando



THE LION-TAILED MONKEY

extremity, measures from half to three-quarters the combined length of the head and body. The thin and tufted tail, like that of a lion, is one of the characteristic features of this species, and that from which it derives its name. The enormous ruff, totally concealing the ears, is, however, that which especially attracts attention, and gives the owner somewhat the appearance of a black-faced old man with shaggy whiskers and beard.

These monkeys inhabit the Malabar, or western coast of India, from Cape Comorin to about 14° N., being especially abundant in the districts of Travancore and Cochin. They restrict themselves to the forest lands on the range of trappean mountains known as the Western Ghats, and are always found at a considerable elevation above the level of the sea. They associate in troops of from twelve to twenty or more in number, and are excessively shy and wary, and when caught are sulky and savage in captivity, so that it is only with great difficulty that they can be taught feats of agility or mimicry.

THE BENGAL MONKEY

Perhaps the best known of the macaques is the Bengal or rhesus monkey (*M. rhesus*), the bandar of the Hindus, found all over Northern India (pages 229, 236). It presents little resemblance to the last species, having no trace of a beard or ruff, and its colour being brown, with a tinge of grey. As a species, it is characterised by the straightness of its moderately long hair, and also by the buttocks being naked for some distance round the callosities. The tail is about one-half the length of the head and body, and tapers regularly from base to tip, without any trace of a terminal tuft. The face, as well as the callosities on the buttocks, is flesh-coloured, except in the adults, in which both are bright red.

In India the Bengal monkey is found continuously northwards from the valley of the Godavari to the Himalaya, extending to the west coast of Bombay. It inhabits the valley of Kashmir and surrounding regions, at elevations of and above four thousand feet. In the neighbourhood of the hill station of Simla these monkeys are found at an elevation of between eight and nine thousand feet above the sea; and it is one of the regular excursions from Simla to ride or walk to see the monkeys on their own hill, which bears the appropriate name of Jako. Here they are regularly fed by a fakir, who has taken up his abode on the same mountain, and they come down in troops at his call. Indeed, these monkeys are almost invariably found in large droves, usually in the forests or more cultivated lands, but occasionally near and in the towns. Although not regarded as sacred, it appears that the rhesus monkey is frequently protected by the Hindus, and in Kashmir the writer has seen them forming part and parcel of the appanages of the temples. In several parts of India the Hindus have, indeed, a strong objection to the slaughter of these monkeys.

The rhesus is an intelligent creature, and, if captured young, is easily taught. It is the common monkey carried about by itinerant jugglers in Northern India, by whom it is taught many amusing tricks. Old animals, more especially the males, become vicious and spiteful.

In their wild state these monkeys make a hideous noise with their incessant chattering, and are always mischievous. In addition to the consumption of large quantities of fruit and seeds, they also subsist on insects and spiders, and parties of them may frequently be seen carefully searching the ground for these delicacies. The rhesus, like the crab-eating macaque, swims well, and takes readily to the water.

It is probable that the Bengal monkey ranges to the north-east into Assam and Upper Burma, and thence into the province of Yunnan, in Western China. In Sze-chuen, and eastwards into the interior of China, it is replaced by the allied but tailless hairy-eared macaque (*M. lasiotis*, page 231).

Another nearly related species is the Himalayan macaque (*M. assamensis*), found at considerable elevations in the Eastern Himalaya, Assam, the Mishmi Hills, and parts of Upper Burma. This species is distinguished from the Bengal monkey by the wavy nature of the hair, which in the Himalayan species assumes a decidedly woolly texture. This Himalayan macaque is also larger than the Bengal species, and more powerfully and more compactly built, and thus approaches the pig-tailed monkey. It is likewise, whether wild or tame, more sluggish in its movements than the Bengal monkey; and there is a slight difference between the voice of the two species.

THE PIG-TAILED MONKEY

The next species of macaque for notice is the pig-tailed monkey (*M. nemestrinus*). It is distinguished from most of those mentioned above by the shorter tail, which is thin and whip-like, and only about one-third the length of the head and

THE MACAQUE MONKEYS

body. It is a comparatively stout and long-limbed monkey, recognisable by the hair radiating from the centre of the head, the slender pig-like tail, and the very projecting muzzle, which approximates to that of the baboons. An adult full-grown male may be compared to a good-sized mastiff, both as regards size and strength. This monkey has been long known to science, and was described by Buffon as the maimon. It inhabits the province of Tenasserim, and thence extends southwards into the Malay Peninsula, and is also found in the islands of Borneo and Sumatra. The voice and manners of this monkey are described as being very similar to those of the Bengal monkey. Its habits were long ago described by Sir Stamford Raffles from specimens observed in Sumatra; and it is stated that the inhabitants of that island train these monkeys to ascend the cocoa-palms, and select and then throw down the ripest fruit. If the story be true, it would seem probable that it must be only young or female individuals that are thus taught to serve their masters, since the old males are exceedingly fierce and vicious, and from their size and powerful build are formidable antagonists.

THE BURMESE PIG-TAILED MONKEY

In Arakan and Upper Burma the place of the pig-tailed monkey is taken by a nearly allied species, the Burmese pig-tailed monkey (*M. leoninus*). This macaque may be distinguished from its relations by its shorter limbs and muzzle, and longer hair, as well as by the black horseshoe-like crest on the temples above the eyes, a feature that stands out in marked contrast to the brown colour of the rest of the fur. Moreover, the short tail, which is generally carried over the back, is more hairy and more or less distinctly tufted at the end. The males are dark brown above, but the females somewhat lighter; the face in both sexes being of a dusky flesh-colour, while the combined length of the head and body is about 23 in.; the tail only measures some 8 in., exclusive of the hair at its extremity, which adds another 2 in. to its length. Mr. E. Blyth, who alluded to this species as the long-haired pig-tailed monkey, in contradistinction to the short-



THE PIG-TAILED MONKEY

haired pig-tailed monkey (*M. nemestrinus*), states that it does not appear to be at all common, and that it chiefly inhabits the range of limestone mountains from the north of Arakan to an undetermined distance southwards. The Burmese pig-tailed monkey serves to connect the other species with the Bengal monkey.

THE BROWN STUMP-TAILED MONKEY

The brown stump-tailed monkey (*M. arctoides*) may be taken as an example of another group of macaques inhabiting Burma and the Malayan region, and thence ranging into China and Japan, and characterised by the reduction of the tail to a mere stump. The species is distinguished by the length of its dark brown or blackish brown hair, which may measure more than 4 in.; and also by the bright red hue of the naked portions of the face and buttocks. As in the last-named species, the terminal portions of the hairs of old individuals are decorated with rings of different colours. The length of the head and body is about 24 in., while that of the tail does not exceed 1 or 2 in. This monkey appears to range from the southern parts of Assam into Upper Burma, and is also found in Cochin China. We have not, however, full information on the subject of its geographical range, and absolutely none as to its habits, but it is said to be an inhabitant of hilly districts. In old individuals the tail is sparsely clad with hair, or naked. In the forests of Sze-chuen the stump-tailed macaques are represented by a species (*M. tibetanus*) characterised by its larger size and the thickly-haired tail. The Moor macaque (*M. maurus*), which has received several names—*M. ochreatus*, for instance—represents the stump-tailed monkeys in Borneo, Celebes, and probably some of the other Malayan islands, and is a dark and black-faced species. In Japan the group is represented by the Japanese



THE HAIRY-EARED MACAQUE

From the "Proceedings" of the Zoological Society

macaque (*M. fuscatus*), which is one of those in which the tail is thickly haired (page 237). There is, however, still much to learn as to the number of species of these stump-tailed macaques, and their exact geographical distribution; while information as to their mode of life is likewise desirable.

THE MAGOT, OR BARBARY MACAQUE

In the preceding pages it has been pointed out that a gradual shortening of the tail can be traced as we pass from the bonnet macaque, through the rhesus monkey and its allies, to the pig-tailed, and thence to the stump-tailed group. From the latter it is but a step to the total loss of the tail; and the magot, or Barbary macaque (the Barbary ape of many authors), is the culminating member of the series. This absence of a tail was regarded as a reason for separating the magot (*M. inuus*) as a distinct genus from the other macaques, but there is no justification for this view, especially as the Chinese rhesus is tailless.

In addition to being the one of two tailless macaques, the magot is the sole existing species which is not Asiatic. The magot inhabits the north-western corner of Africa, in the districts of Morocco and Algeria, being especially common in the latter country in the neighbourhood of the city of Constantine. It is also found, across the strait, in Gibraltar and some of the neighbouring parts of Spain, but whether indigenous there, or introduced from the opposite continent by human agency, has not been clearly made out. The wide separation of the macaque from its Asiatic congeners suggests that it is the direct descendant of those extinct species which are found in the later geological deposits of various parts of Europe, at a date when we know that the genus was already in existence in India.

That the magot is the *Pithecus* of the ancients there is no doubt, as the description given by Aristotle is enough to identify it. This species was, indeed, in all probability, the only tailless member of the order with which the ancients were acquainted. It was, moreover, the animal from which the ancient Greeks obtained such knowledge as they possessed of human anatomy; and an account of its anatomy, given by Galen, has been handed down to our own times. The name magot is of French origin, and was applied by Buffon.

This monkey is as large as a good-sized dog; and the upper parts of its body, and the outer sides of the limbs, are of a light yellowish brown, becoming somewhat deeper on the head, and also along a line bordering the cheeks. The under parts are a dull yellowish white, while the naked portions of the face, hands, and feet, as well as the callosities on the buttocks, are flesh-coloured. The rudiment of the tail consists merely of a little fold of skin, having no sort of connection with the end of the backbone (pages 35, 233).

One of the best early original accounts of the magot is given by the French naturalist René-Luiche Desfontaines, who resided for some time

in Algeria, during the closing decades of the eighteenth century. This writer observes that the magots "live in troops in the forests of the Atlas Mountains nearest to the seaboard, and are so common at Stora that the surrounding trees are sometimes covered with them. They live upon the cones of the pine, sweet chestnuts, and the figs, melons, pistachio nuts, and vegetables which they steal from the gardens of the Arabs, in spite of all the pains taken to exclude these mischievous animals. Whilst in the act of committing these thefts, two or three detach themselves from the general body, and keep watch from the tops of the surrounding trees or rocks; and as soon as these sentinels perceive the approach of danger, they give warning to their companions, who presently scamper off with whatever they have been able to lay hands on."

An officer, writing in 1880, in "The Field," gave the following excellent account of the magots at Gibraltar. "These apes were formerly very numerous on the Rock, and there were several gangs of them, but they were so predaceous in their habits, coming down to the gardens in the upper part of the town, and stealing fruit, especially figs, that they were killed by trap or poison, so as nearly to bring about their extinction. In November, 1856, a garrison order was published for the guidance of the signalmaster," which forbade the destruction of the monkeys, and gave directions as to their being counted at regular intervals. "From that time," continued the officer, "the register has been very regularly kept by the signalmaster. There were only four or five at this time, and but three in 1863, when General Sir W. Codrington, who was then governor, saved them from destruction by a fresh importation from Africa. The following note occurs in the Journal of May 26, 1865: 'Turned out four apes, wild from Barbary, two males and two females, all young.' After some time the newcomers made friends with the apes of the old stock; and the band increased, but very slowly, however, owing to the great preponderance of females, until the present time, and it may be expected, as the signalmaster observes, now that there are two adult and rival males, that it will divide. Those who wish to see them will do well to remember that their haunts on the Rock are determined by the direction of the wind. They prefer the ledges of the [to man] inaccessible, abrupt escarpment of the Mediterranean face; but cannot stand the cold, damp Levant wind, which, as its name indicates, blows from the east, and compels them to resort to the western slopes on the town side of the Rock. At the bottom of Charles V.'s wall, overhanging the Alameda Gardens, is a favourite spot. On the western side, the Monkeys' Alameda, a small bushy plateau half-way down the precipice, is another choice resort, as is also Monkeys' Cave, close to the sea. Of late years they have become sufficiently confident in their friend and protector, the signalmaster, frequently to enter the enclosure of the station, especially in the summer drought, when they come for water. In a letter to me, of May 3rd,

THE BLACK APE

Sergeant Brown, the signalmaster, says: 'The monkeys are sitting on the wall of the station as I write this—the first time this season that they have come up for water.'

"Their food consists of grass, the young blades of which I have seen them eating with avidity, and of a variety of roots and bulbs; those of the yellow Cape oxalis being much sought after. The fruits of the palmetto—'monkey dates,' as the Gibraltar urchins, who also much appreciate the little brown viscous clusters, call them—are greedily devoured when ripe. The signalmaster has never observed them take any food left in their way but a few grapes, of which they seemed very fond. . . .

"Sometimes a fight occurs among the monkeys, when it is surprising to witness the rapidity with which they will follow an offender down the stupendous precipice of the eastern face; tumbling one after another, and catching at bits of bush or protecting ledges on their way, they descend hundreds of feet in a moment or two. Sometimes the sergeant dresses wounds on them, probably from this cause, but they soon heal up."

According to recent reports, these apes are now nearly, if not completely, exterminated in Gibraltar. In captivity the magot, at least during youth, is lively, active, intelligent, and good-tempered; but with advancing years it becomes sullen and capricious, and finally spiteful and vindictive. The French naturalist Frédéric Cuvier observes that the natural instinct which causes these monkeys when in a wild condition to associate in troops leads solitary individuals in confinement to make friends of such animals as they are thrown in contact with. Such animals, if sufficiently small, are carried about by the magots, which hug and caress their burdens, and become furious when any attempts are made to remove them.

The magot is perhaps brought oftener to Europe than any other monkey; its native climate being such as to permit of its existing with tolerable comfort in more northerly regions.

EXTINCT MACAQUES

In describing the magot, incidental reference was made to the occurrence of fossil species of macaques; but as this is a subject of considerable interest to the present geographical distribution of these monkeys, we must say a few words more. Asia being the headquarters of the group, it would only be natural to find these monkeys represented in a fossil state

on that continent. As a matter of fact, with the exception of India, comparatively little is known of the geology of Asia. In India, however, remains of macaques are found in the caverns of Madras, and in certain Pliocene deposits in the Punjab.

In Europe fossil macaques occur in freshwater deposits belonging to the same Pliocene period, in the south of France, Switzerland, and the north of Italy, in the valley of the Arno. The occurrence of these extinct monkeys need not imply any very great change of climate in those regions. The case is, however, very different with the single fragment of the jaw of a macaque which has been found fossil near the village of Grays, in Essex, in strata which belong to the latest or Pleistocene epoch of geological history. This monkey must have lived in England during the time when man had already made his appearance; and there is no doubt but

that the climate must then have been milder than it is at the present day. As we have said, these extinct European macaques may be the progenitors of the magot.

In addition to remains of macaques, there occur in the Pliocene rocks of Attica and the south of France those of other monkeys which appear to indicate a transition from the macaques to the langurs. These monkeys, known as the mesopitheque and the dolichopitheque, have indeed short and stout limbs like those of the macaques, but skulls resembling those of the langur. As we shall never know the structure of their soft parts, their exact relationships cannot be determined.



THE BARBARY APE, OR MAGOT

THE BLACK APE

The island of Celebes is remarkable for several peculiar types of mammals, among which is the black ape (*Cynopithecus niger*), the sole representative of a genus in some respects connecting the preceding group of the macaques with the following one of the baboons. It was represented many years ago by a living example in the old menagerie at the Tower of London, and by another in that of Exeter 'Change, in the Strand. At that time, however, the true habitat of this animal was quite unknown, Cuvier suggesting that it came from the Philippines; but its home was subsequently found to be Celebes. This monkey (page 235) is a striking animal, the whole of the fur, as well as the naked parts of the face, hands, and feet, being of an intense black, the only exception to this colouring being the large callosities on the buttocks, which are flesh-coloured.

The hair of the body is long and woolly, but that on the limbs shorter. The tail is represented by a mere tubercle, not more than an inch in length. The face is characterised by the marked production of the muzzle, which terminates bluntly, with the nostrils opening obliquely, and placed some distance behind the extremity of the muzzle. It is this position of the nostrils which connects this monkey with the macaques, and distinguishes it from the true baboons, in which the nostrils are situated at the very end of the still more produced muzzle. The sides of the face have the peculiar longitudinal swellings characteristic of the latter, and the cheek pouches are very capacious. On the top of the head the black ape has a broad tuft of long hairs, curling backwards, and forming a very characteristic crest.

The earlier specimens of this monkey brought to England are described as being rather violent in temper, and tyrannising over the other monkeys with which they were placed in company. Others, however, are stated to have been more gentle in disposition, and thus very different from the fierce baboons. But few specimens of this monkey have been exhibited of late years in the Zoological Society's Gardens in London.

The black ape is very common in the forest near Wallace Bay, in Celebes, where these animals may be seen swinging from bough to bough in small flocks. This monkey is also found in the small island of Batchian, lying to the east of Celebes, and forming a part of the Molucca group. On account of the circumstance that none of the other mammals of Celebes extends to Batchian, it has been suggested that the black ape has been accidentally introduced by Malays, who often carry about with them monkeys and other animals. This is rendered more probable by the fact that the animal is not found in Gilolo, which is only separated from Batchian by a very narrow strait. The introduction may have been very recent, as in a fertile and unoccupied island such an animal would multiply rapidly. In its arboreal habits and predilection for fruit, the black ape is essentially a macaque, and not a baboon.

R. LYDEKKER

STORIES OF THE MONKEYS

It is always difficult to decide whether the performances of monkeys are the outcome of cruelty on the part of their trainers, or whether the animals themselves derive pleasure from the show. They have skill enough to achieve wonders, but the net result in such environment is not equal to that accomplished by, say, a dog of ordinary intelligence. This suggests that the monkey may not be a willing pupil. As a mimic he is, of his own initiative, almost incomparable. He seems, however, to have something of that pride of spirit which makes an elephant kill itself rather than resign its task to another.

In the Ceylon Village at the White City, in 1908, were many natives with performing monkeys. The latter did nothing more remarkable than was to be seen at an ordinary monkey show, but on one occasion an interesting exhibition took place that was not in the programme. A youngish Sinhalese

squatted down before the little school, and set a small monkey to work. The latter appeared to have friends among the children, for instead of going through its round of tricks in the usual way, it watched the bairns at their lessons and seemed anxious to get to them. Its master, after one or two remonstrances, pulled it up to him by its chain, gave it a gentle cuff, and set it down, retaining its chain upon his wrist. Then he produced a second and larger monkey, and prepared to put it through its facings.

The lesser monkey, which had borne its punishment with resignation, became furious at the appearance of a rival performer. Like a flash it darted at the seated man, sprang on his shoulders, and tried to bite him on the back of the neck. He good-humouredly pulled it down and threw it on its feet, a yard away from him, and turned his attentions to the other monkey. The insulted performer, however, would not be put off in this way. With screams of rage it attacked its master again and again, biting at his hands and arms as he endeavoured to keep it at bay. It was in vain that the man scolded and cuffed; every time he tried to make the other monkey perform, the little one, with cries of fury, dashed at him. The larger monkey looked on with hair on end and jaws agape, the picture of suppressed rage and perplexity. It did not know whether it ought to attack its rival, or make common cause against its master.

For two or three minutes this curious contest lasted, and ended in the victory of the small monkey. For an elderly member of the Sinhalese party, drawn to the spot by the uproar, and seeing what had happened, ordered his countryman to rise, while he himself took charge of the two monkeys. At the first sound of the dice-box drum which the newcomer rattled, the rebel sidled up to him with a look upon its strange little face which could only be interpreted as a plea for permission to perform. Leave being given, the monkey went through its round of tricks like the most obedient child. Its master stood by, looking on and laughing. Every time the monkey saw him it bared its teeth and chattered with rage, and, but for its anxiety to acquit itself with credit before its new master, would have flown at him.

There are depths of intelligence in the monkey's mind which few, if any, of us can plumb. How much they know, or of how much knowledge they are able to make themselves master, it is impossible to say. There is something uncannily keen in their perceptive faculties, something like intuition, as was said of Frank Buckland's baboon (page 249). This faculty discovers itself in divers ways. We are indebted to Darwin for one admirable example. A keeper at the London Zoological Gardens was attacked by a savage baboon, which fixed its terrible teeth in the back of his neck as he knelt on the floor of its cage. In the same cage was a little American monkey, with which this keeper was a special favourite. Here was a position of the like of which the creature could not previously have had experience; there was nothing to guide its course of action. It saw its friend being slowly killed by the one

STORIES OF THE MONKEYS

animal of which it went in deadly terror, the despotic lord of the cage—this fierce baboon. In ordinary circumstances the monkey would have avoided the baboon as it would have avoided fire, but its love for its human friend gave it courage. It leapt upon the shoulders of the baboon, and, by screaming and biting, so distracted its attention that the man was able to escape from the cage. But for the intervention of the ordinarily timid little monkey the man would in all likelihood have been slain.

Another way in which the monkey displays this curious intuitive faculty is illustrated by Mr. Frank Finn in his "Ornithological and Other Oddities." In one of the cages of the Calcutta Zoological Gardens were three monkeys—two plump females and a gaunt and feeble-looking male. Noticing the miserable condition of this animal, Mr. Finn remarked one day to an assistant that it had better be put out of its misery. "Scarcely, however, were the words out of my mouth," he says, "before both female monkeys sprang straight at my face, and nothing but the intervening wire saved me from getting bitten. Of course, they could not have understood what I said, but I feel sure their sudden attack was not an accident, and that in some strange way they had divined that I was meditating something against their companion."

A further example of the monkey's alertness may be furnished from the writer's own experience of an intelligent rhesus, whose temper had deteriorated as his wits had been sharpened by a long course of misery on tramp with an Italian. This monkey paid regular visits to a certain garden, and knew exactly the spot to which he must go to be fed; where he might climb and where not. He would be regaled with all sorts of dainties, but his chief joy was a piece of raw potato. After his meal, he would stretch himself on his side on the grass, sated and not very grateful. He quickly knew that tricks were not expected of him in that garden, and a tug at his tether, ordinarily the signal for the performance of some duty, provoked him to rebellion.

One day, when in a specially perverse mood, the rhesus insisted, after his rest, upon climbing the house by way of a creeper, the upper reaches of which were still young and tender. "Better not let him go any higher," remarked the writer to the monkey's

owner. A slight pull at the chain was given. The monkey looked sharply round, took a couple of steps down, then leapt ten feet to the ground, bounded across the border with incredible swiftness, and did his best to make his teeth meet through the calf of the well-intentioned host. The latter was several yards from the owner of the monkey, and the owner held the chain which had been tugged. But the host had spoken the word that had caused the owner to pull the chain, and punishment must be meted out to him. The victim forbade reprisals, but during the remainder of his stay the monkey avoided him, not now in anger, but with a demeanour which suggested a feeling of shame, if the application of such a term to a monkey may be pardoned.

But we must not expect to find all monkeys im-

bued with the same wonderful sense of affection and gratitude which saved the keeper's life. The spirit of mischief rules their small minds. Mr. Gambier Bolton, when in India, went to great trouble to conciliate a number of the sacred hanumán monkeys, which he found wild. After the expenditure of vast patience and sugar and meal, several came about him, and when they had eaten their fill, one reached down from a ruin to which it had climbed and, with a hearty thump, expressed its gratitude by sending his pith helmet flying.

Sir Samuel Baker's pet monkey, a red one from Abyssinia, which he called "Wallady," was as big a rascal,

and put his owner rather in a fix upon a certain fatiguing march. The traveller had caused a large quantity of black pancakes to be prepared for food for himself and escort on the march. The store was carried in a hamper on the back of the camel on which "Wallady" rode. When the food was sought for at a point when the whole party were famished, and beyond the reach of other supplies, it was found that the pancakes had all disappeared. The monkey had eaten as many as he wanted, and thrown the rest away. "Wallady" atoned, however, in a thousand ways. He was better than any watch-dog in preventing natives from becoming too pressing in their attentions upon the party. With white folk "Wallady" was affectionate and tolerant, but he had no respect for black men, and attacked the calves of dark strangers with such



THE BLACK APE

good will that they were only too glad to escape beyond his reach. He was useful, too, as evidence of the peaceful mission of his master, for no man in his senses, it was argued, would travel with hostile intent taking a monkey with him.

The life of the monkey in many points touches the human. In several respects the average monkey is like a growing child, and in nothing more than its insatiable passion for mischief. Frank Buckland's monkey, which so scandalised the dons at Christ Church College, Oxford, rewarded the kindness of its master by rending to shreds an important treatise which he had written for his examination. One of equally mischievous disposition was kept by an enthusiastic entomologist who had devoted years to collecting the rarest of beetles and butterflies. One luckless day he left open the door of his study, and, in the master's absence, the monkey invaded the sanctum. The naturalist returned some time afterwards, to find that the little imp, giving rein to its appetite for beetles and love of mischief, had not only eaten the whole entomological collection, pins and all, but had pinched out and swallowed all the coloured pictures in a valuable work on insects which had been left open. Needless to say, the pins were too much for the digestion of the poor monkey, which shortly afterwards died. Its destruction of the pictures is interesting, as showing that it had mistaken them for the genuine insects. It has been regarded as wonderful that an intelligent, well-trained dog should recognise the portrait of its absent master, but this monkey was at least as complimentary to the artists who had drawn the beetles and butterflies.

A certain "Jeremiah," an Indian specimen, has received the dignity of a biographical notice in "The Spectator." It was called "Jeremiah" because of its intensely dismal expression, but a world of mischief lurked at the back of its little head, and in its heart an abiding affection for its master. But no sense of affection or of gratitude could prevail against its love for the thing which should not be done. Hence, after nestling with pathetic joy in its owner's arms, it would immediately steal some treasured vase or other precious nick-nack, climb with it to the top of some tall tree in the garden, and hurl it to the ground. The scene was India, and its master, having to move from one station to another, magnanimously permitted "Jeremiah" to ride in the new English dogcart which he had just bought. The cavalcade had not gone far when a couple of buttons were twisted off one of the cushions, a hole was bitten in the cloth, and the monkey's paw was drawing out the stuffing

in handfuls. "Jeremiah" was therefore condemned to walk, and a very weary, travel-stained little monkey arrived, hungry and thirsty, at the end of the long day's journey.

"Jeremiah" had evidently pondered this indignity, and decided upon a plan of campaign. When it was given its supper, the men noticed that it sought out a bigish black dog from among the crowd of outcast dogs which hung about the

camp, and offered it part of its meal. The next morning "Jeremiah" fed the dog again. Thus it succeeded in beguiling it into following the march, and, by and by, jumped on to the dog's back and rode in triumph. Every day the proceeding was repeated. The monkey rode the whole of the remaining eighty miles on the dog's back. Every night it shared its supper with its courser, and slept curled up close to it.

"Jeremiah's" parting from civilisation was in keeping with its association with it. Its master, having again to move, decided to give the monkey away. As he mounted his horse when quitting the bungalow, he saw the deserted "Jeremiah" come from one of the rooms where packing was going on, and speed across the carriage-drive. Under its arms were two cherished Venetian glass vases; a metal ornament

was in one hand; a small pair of bellows in the other. Its cheek pouches were distended with stolen dainties. When it saw that it was observed, it darted up a tree, flung down the vases with an angry scream, bit a hole in the bellows, hurled them down after the vases, then, with a triumphant chatter, climbed to the upper branches and was seen no more.

A more amiable monkey was committed to the charge of Mr. Arthur Maclean, who was at that time principal of Brighton College. He was returning from an Indian trip, and a friend who was moving up-country begged him to convey the monkey home. Consent was readily given when the owner said: "I have so high an opinion of her qualities that I have appointed her guardian of four little orphan puppies." The new owner had the monkey and her foster children taken into his room, and, as he was busy, gave her some nuts. Nut-receiving time is always a moment of embarrassment for a monkey, for, after filling its cheeks and its four hands, its powers of receptivity, but not its desire for more, are exhausted. The position was especially difficult now, for she was chained to her pole, and four rampaging pups might escape from her while she ate her nuts. She puckered up her little face in study for a moment, then inspiration came to her. She took pup number one, and laid it on the floor; number two she laid with its head in the opposite direction; numbers three and four were placed in



THE RHESUS MONKEY

STORIES OF THE MONKEYS

positions to complete the square. Their tails all pointed inwards, making together a cross. Then she sat down upon the tips of all four tails. She was at liberty then to eat her nuts in peace. If one of her charges managed to wriggle away from her, she had time to collect it again and restore it to its original position, not, however, without first giving it a gentle smack by way of rebuke.

It would have enhanced the interest in the story of the aforesaid "Jeremiah" if the author could have rounded it off with some glimpse of the hero in a state of freedom. To turn into the wilds a monkey which has been domesticated is not always a kindness to the animal. Dr. H. O. Forbes kept in captivity for some time a wow-wow gibbon (*Hylobates leuciscus*), a most engaging creature. When the calling of its free mates reached its prison, the ape used most pathetically to place its ear close to the bars of its cage and listen with such intent and eager wistfulness that it was impossible any longer to retain it in durance. It was accordingly set free on the margin of its old forest home. Strange to say, its former companions, perceiving, perhaps, the odour of captivity about it, seemed to distrust its respectability, and refused to allow it to mingle with them. Possibly "Jeremiah" may have found his reception as chilly.

There are always a certain number of outcast males to be found where the hanumáns make their home. The explanation is curious. The lord of the herd tolerates no rivals in his seraglio, and when a young male is born he kills it. When this has happened once or twice, the females appear to realise the situation, and, seizing the infant male monkey, disappear into the jungle, or high up the mountain-side, there to hide until the young male is able to look after himself. The youthful outcast bides his time. He dwells in solitude apart, and waxes strong. When he reaches maturity, he sets out to conquer the leader of a herd. There is a terrible battle, and, if the young one be fully grown and the old champion past his prime, victory lies as a rule with the challenger, and the seraglio thus gets a new lord.

The lethal instinct will out even among captive monkeys. Colonel Rice, whose circus included a number of American monkeys, was puzzled by a series of deaths in this interesting family. The deaths were not due to illness, for a monkey which was quite well overnight would be found dead in the morning, hanging by its tail from its perch. The wisecracks of the show declared that the victims had committed suicide; but Rice set a man to watch, and discovered that not suicide, but murder, was being committed. The victims had all

been males; their murderer was their own sire. The culprit was removed, and there were no more deaths. Rice declares that the murderer, after committing his crimes, deliberately hanged his victims upon their perches to divert suspicion from himself.

The red-faced spider monkey, or coaita, of which Bates gives some extremely interesting details is among the best-tempered of monkeys, but a shocking thief of anything which it can convert to the purpose of bedclothes. The coaita does not monopolise this unenviable distinction. There was another of different breed to whose account was laid, in 1905, the destruction of scrip representing a considerable amount in the Bank of France. At an earlier date an unfortunate member of the simian family was accused of ravages among vouchers of the London Zoological Society, so making it impossible satisfactorily to account for a deficiency. However, the reputation of that monkey was cleared.

Monkeys are blessed with good memories as well as ready, perceptive faculties. No matter how ample the supply of food from visitors, the monkeys at the London Zoo are all attention the moment their keeper puts his head through the doorway of their chamber. Monkeys temporarily lodged in the Gardens recognise their owners when the latter visit them. A striking example of the monkey's memory was given during a performance in a variety theatre at Copenhagen. In the middle of its "turn" a monkey suddenly sprang off the stage and threw itself into the arms of a man in the audience. The man, it proved, had owned this very monkey four years before.

A short acquaintance with a brown capuchin served to make it the faithful friend and admirer of Romanes. This was the monkey which he borrowed from the Zoo in order that he and his sister might keep it under observation. The monkey took a violent liking to him. The sound of his voice two flights of stairs away would set it yelling with delight, and when he entered the room the capuchin screamed with such power that it was impossible to converse even by shouting, until the monkey was taken up in his lap, when it settled down placidly with every sign of intense affection. The monkey was detained in the



JAPANESE MACAQUES AT THE ZOO

house under surveillance for about ten weeks, and it lived about two years longer. Every time Romanes entered the Zoo monkey-house, no matter how crowded it might be, the monkey would instantly espy him and dash across its cage towards him, and thrust its hands between the bars with every expression of joy. When he moved away it would follow him to the end of its cage, and remain watching as long as he was in sight.

No more interesting chapter on monkey intelligence has been written than that which Miss Romanes furnished for her brother's book on her experiences with this animal. Untaught, it learned the secret of the screw, puzzled for two hours over the problem of lock and key, threw things when angry, and, when good-tempered, insisted on sharing its food with its mistress, popping a pawful of milk and bread into her hand when she was not looking. Frank Buckland complained that, though he had lived with monkeys about him for years, he had never seen one attempt to put anything on the fire. This one, however, delighted to thrust sticks into the fire, and to smell their smoking ends; to pass hot cinders over its head and chest to feel the warmth. A piece of paper was given to it, and as the chain was too short to allow it to reach the fire with the paper in its existing shape, it rolled it up in the form of a spill, and then thrust the end into the fire, withdrawing it when it was alight. Miss Romanes next gave him a newspaper. He tore it in pieces, rolled up each piece to make it long enough to reach the fire, and so burnt all.

Curiously enough, what most terrified this monkey was a toy model of himself. With a live monkey doubtless he would have fought, but this imitation one scared him extraordinarily. His behaviour before a mirror was very different from that which we generally expect of monkeys. Lieut.-General F. H. Tyrrell has described the antics of his pet monkey before a mirror placed on the ground. Seeing his own reflection in the mirror, the monkey imagined it to be another monkey, so sprang round the glass, to find nothing there. Returning, he looked intently at the reflection, and again rushed round to disappointment. Once more he returned, but this time he fixed his gaze upon the monkey in the mirror, and, keeping him in sight, stretched his paw round to the back of the glass to feel for the elusive stranger. Romanes' monkey behaved differently. At first he was a little afraid of the reflection in the mirror, but in a short time he gained courage enough to approach and try to touch it. Finding that he could not do so, he went round to the back and then to the front, repeating this a number of times. He appeared to mistake the sex of the image, and began in the most ludicrous manner to pay it the addresses of courtship. First placing his lips against the glass, he rose to his full height on his hind legs, retired slowly, and, looking over his shoulder at the image, with a preposterous "pinch" in his back, strutted up and down before the glass with the most absurd conceit.

We have seen that whereas the gibbon's interest in its kind is limited to the life of the latter, the dead being ignored, the orang-utan will, whenever possible, carry off its fellow which the hunter has shot. This affectionate instinct is discovered in certain monkeys also. Some species will carry their dead young about with them for weeks, until the corpses become mummies. As the mothers fondle and endeavour to feed them, it is likely they do not realise that death has taken place. Wallace's young

orang-utan was as content with a stuffed dummy of its dam as was the cow which, refusing her milk unless her calf were before her, was satisfied with one made of hay stuffed into a calf-skin. When the latter got damaged and the hay protruded, the cow ate the hay, in blissful ignorance that such a substance should not issue from the hide of her little one.

In the affection of some animals there is a blind instinct, and the devotion of female monkeys to their dead young seems to be of that order. But we touch a higher note in a case cited by Mr. James Forbes in his "Oriental Memoirs." One of a party had shot a female monkey, and carried it to his tent, which was soon surrounded by forty or fifty monkeys. These made a great noise and were disposed to attack the aggressor.

"They retreated when he presented his fowling-piece, the dreadful effect of which they had witnessed, and appeared perfectly to understand. The head of the troop, however, stood his ground, chattering furiously. The sportsman, who perhaps felt some compunction for having killed one of the family, did not like to fire at the creature; and nothing short of firing would suffice to drive him off. At length the monkey leader came to the door of the tent, and, finding threats of no avail, began a lamentable moaning, and by the most expressive gesture seemed to beg for the dead body. It was given him. He took it sorrowfully in his arms, and bore it away to his expectant companions. They who were witnesses of this extraordinary scene resolved never again to fire at one of the monkey race."

That resolve has been expressed by all but the most hardened of hunters. The look of agony which comes to a stricken monkey's face, the human gesture with which it displays its wound to its murderer, are more than any man of feeling can endure. All hunters present the same report—the death of one of the Primates, be it gorilla, orang-utan, or common monkey, vividly recalls the death of a human being. It is the repugnance of hunters to take the life of creatures so nearly like man that accounts for the paucity of monkeys in museums.

In the foregoing incident there is evidence of a determination to rescue a companion, alive or dead. It agrees with the action of baboons bent on reclaiming their captured companions; but reveals no higher example of solicitude than is revealed by a bear that will follow a vehicle at startling speed to recover its captured cub. In Captain Hugh Crow's "Narratives of My Life," however, in an example furnished by Sir James Malcolm, we see discrimination and initiative as well as anxiety. On board the steamer by which Sir James travelled were two common monkeys from India; the one full grown, the other younger. The smaller monkey one day fell overboard. The larger one became frantically excited and, running to the side, held on by one hand, leaned over and, with the other hand, extended to the monkey in the water the cord by which the would-be rescuer was tied by the

THE GELADA BABOON

waist. The attempt was unsuccessful, but the little monkey was able to keep swimming until a sailor threw a rope, enabling it to climb on board.

That a monkey should swim so well in the sea need not surprise us. Man is the only animal that does not swim naturally upon compulsion. In August, 1907, pleasure-seekers on the Clewer race-course at Windsor were surprised to see a monkey, dripping with water, make its way to the grand stand. The animal, which had escaped from captivity on an island up the Thames, had ravaged the neighbouring gardens, and then swam the river, as if curious to see what was attracting so many excited people on the racecourse. Having had several days of liberty—during which it had given full play to its fancy for destroying garden flowers—it now submitted to be captured with the best of grace, and was carried back to its home none the worse for its long swim.

The monkey-house at the Zoological Gardens in Regent's Park affords an endless entertainment to the observer. The sociable monkeys are kept in the cages which occupy the centre of the hall; the less amiable ones fill the compartments flanking the house. The inmates enjoy the excitement of a full house, and provide a wonderfully interesting study of the ways of our poor relations. In one particular the monkey is a much misunderstood animal. When we see him sedulously rummaging the fur of his neighbour, we are not to suppose that he is in quest of insects, or that the searcher carries them

upon him. As a fact, the monkey keenly relishes insects as part of his diet, even as certain races of men do; but the object of those everlasting searches which the public witness is a salty secretion from the skin of the monkey which the searcher enjoys to eat.

Curiously childlike in his whims, in his likes and dislikes, in his impulses and persistent if futile industry, the monkey is not to be commended as fit to be the inmate of every home. But he has so many good and interesting qualities that at least we must raise our voices against the abominable cruelty to which he is submitted in his life of slavery and misery as the adjunct of the organ-grinder's paraphernalia.

E. A. B.

THE GELADA BABOON

The baboons, or dog-faced monkeys, are so called from the great prolongation of their muzzles, which far exceeds that obtaining in the black ape, and gives to them an expression quite different from that of any other members of the order. Their other peculiarities are mentioned in the description of the true baboons, and it will accordingly suffice to indicate here the chief characteristics of the extraordinary-looking gelada.

The gelada (*Theropithecus gelada*) is an inhabitant of the southern parts of Abyssinia, and is distinguished from the true baboons by the fact that the nostrils are placed some distance behind the extremity of the snout. In this respect, therefore, the gelada

forms a connecting link between the black ape of Celebes and the true baboons.

The gelada is of comparatively large size, and dark in colour; the shoulders, back, rump, and forearms, and most of the naked parts, being deep black, whereas the head, whiskers, neck, and sides are a sooty grey, sometimes tinged with brown. The most peculiar feature about the creature is the great mantle of long black hair growing from the neck and flowing over the shoulders. The flesh-coloured chest is naked, while the moderately long tail is cylindrical, and furnished with a long black tuft at the end.

Taken altogether, the aspect of the gelada forcibly suggests a big black poodle dog, with an unusually abundant mane. The mode of life of this species is very similar to that of the true baboons;



THE GELADA BABOON

geladas living in large troops, and being especially addicted to rocky regions, whence they descend to plunder the cultivated grounds of the natives, occasionally entering into conflict with troops of the mantled baboon. Examples of the gelada have been exhibited in the gardens of the Zoological Society in Regent's Park.

THE TRUE BABOONS

With the true baboons and their allies forming the genus *Papio* we come to some of the most hideous members of the primates; their repulsive appearance being only equalled by the fierce and untamable disposition of several species of the group.

All the baboons are confined to Africa and the countries on the north-east of the Red Sea, so that they are totally absent from the Oriental region. They are found over the whole of Africa, but it is only on the west coast that the short-tailed baboons, which form a genus by themselves, are met with. Next to the man-like apes, the baboons include the largest members of the order, some of the species being as large as a pointer dog.

While agreeing with the gelada baboon in the great length of their snouts, the true baboons are readily distinguished from that species by the nostrils being placed at the very extremity of the snout; indeed, in the mantled baboon they actually project slightly beyond the upper lip, as is the case in most dogs. This canine form of countenance led the ancient Greeks and Romans to apply the name *Cynocephalus* ("dog-headed") to this animal, and this name was for many years adopted in scientific phraseology as the distinctive appellation of the group. This great prolongation of the snout shows that the baboons are the lowest of the Old World monkeys, and they bear the most marked signs of relationship with the inferior orders of mammals.

In addition to their long snouts, baboons are distinguished by the large proportionate size of their skulls, this being most obvious in some of the West African kinds. Moreover, the bones forming the upper jaw are greatly inflated, so as to give a swollen look to this part of the face in some of the species. They may also carry prominent oblique ridges, which form the support for the peculiar fleshy tumour-like structures occurring in two West African species which are assigned to a genus by themselves.

In all the baboons the callosities on the buttocks are unusually large, and may be very brightly coloured. In the true baboons the tail is of moderate length. The arms and legs, or, as they may be better termed, fore and hind legs, are nearly equal in length, and thus far better adapted for progress on the ground than for climbing. Indeed, none of the baboons is an adept at climbing, and many pass almost all their time on the ground. Several species show an especial predilection for rocky quarters, and are accustomed to go in large troops—this association being necessary for defence against the attacks of leopards and other carnivores, to which their terrestrial habits expose them (see page 210).

Their defence does not, however, rest solely on the strength of numbers; for the male baboons, which are superior in size and strength to their consorts, are armed with tusks of the most formidable dimensions. Indeed, a bite from one of these animals must be almost, if not quite, as severe and dangerous as a leopard's; and there are instances where leopards have been attacked and mastered by a few old male baboons.

The great size of the head, coupled with their general bodily conformation, renders all the baboons much less capable of assuming and maintaining the erect posture than any of the other Old World monkeys. They are, indeed, accustomed to go almost invariably on all-fours; and when on tolerably flat ground can gallop at a pace that requires a horse to overtake them. When brought to bay, a baboon will, however, sit up on its hind quarters to defend itself more readily.

In the wild state scarcely any kind of food comes amiss to baboons; and although the bulk of their nutriment may take the form of seeds, fruits, roots, and the gum which exudes from the stems of many of the African acacias, they also search for and eat insects, lizards, and birds' eggs. In regions of cultivated land much harm is done by the nocturnal excursions of baboons. During such raids many travellers state that certain members of the troop are selected to act as sentinels to give timely warning of the approach of an enemy. How much credence is to be lent to the assertions that on these occasions the marauders range themselves in long lines leading from the cultivated ground to their homes, and pass the stolen plunder from hand to hand, it is difficult to decide.

In disposition the baboons are the reverse of amiable, and fly into paroxysms of fury at any object which enrages or excites them; but some of the species are capable of being more or less completely tamed, and even learning a certain number of tricks; and it appears that members of one species were habitually tamed by the ancient Egyptians.

To show that baboons were known in Europe at least two centuries ago, the following account may, because of its interesting and quaint character, be quoted. It is extracted from a work by Job Ludolph, relating to ancient Ethiopia (the modern Abyssinia); the English translation being published in the year 1684. "Of apes," writes Ludolph, "there are infinite flocks up and down in the mountains, a thousand and more together; there they leave no stone unturned. If they meet with one that two or three cannot lift, they call for more aid, and all for the sake of the wormes that lye under; a sort of diet which they relish exceedingly. They are very greedy after emmets [ants]. So that having found an emmet hill, they presently surround it, and, laying their forepaws with the hollow downwards upon the ant-heap, as fast as the emmets creep into their treacherous palms, they lick 'em off with great comfort to their stomachs; and there they will lie till there is not an emmet left.

THE TRUE BABOONS

"They are also pernicious to fruit and apples, and will destroy whole fields and gardens unless they be carefully look'd after. For they are very cunning, and will never venture in till the return of their spies, which they send always before; who giving information that all things are safe, in they rush with their whole body, and make a quick dispatch. Therefore, they go very quiet and silent to their prey; and if their young chance to make a noise, they chastise them with their fists; but if they find the coast clear, then every one hath a different noise to express his joy. Nor could there be any to hinder them from further multiplying, but that they fall sometimes into the ruder hands of the wild beasts, which they have no way to avoid but by a timely flight, or by creeping into the clefts of the rocks. If they find no safety in flight, they make a virtue of necessity, stand their ground, and, filling their paws full of dust or sand, fling it into the eyes of their assailant, and then to their heels again."

Although, having regard to the date at which he wrote, it is possible that Ludolph may have mixed up some other monkeys with them, there can be little doubt but that in the main this account refers to the mantled baboon, still so common in Abyssinia. This identification is supported by his mention of the large number of individuals in a troop, by the reference to rocks, by the search after insects, and also by the allusion to encounters with leopards. It must, however, be confessed that the figures of monkeys with which Ludolph's narrative is illustrated bear but little resemblance to baboons, although this may well be explained by the degree of licence which the engravers of his epoch allowed themselves in such matters.

THE MANTLED BABOON

The mantled, or sacred, baboon (*Papio hamadryas*) is the species often represented on the ancient monuments of Egypt, and may be recognised by its ashy grey colour, and the large mantle or mane with which the neck and shoulders of the males are covered. The males of this species are about as large as a good-sized pointer dog. The tail is of considerable length, and terminates in a tuft of long hair. The face has long whiskers of a slaty colour, and is itself, like the ears, flesh-coloured. The hands are black, and the large naked callosities on the buttocks bright red. The shaggy mane on

the neck and shoulders of the males extends backwards over a considerable portion of the body; and all the hairs are ringed with different colours, so as to produce that speckled appearance common to so many African monkeys. The females and young are quite devoid of this mane; the former being nearly as large as the males. The snout is very long, and has not the prominent tumour-like swellings characterising the short-tailed baboons. The nostrils pro-

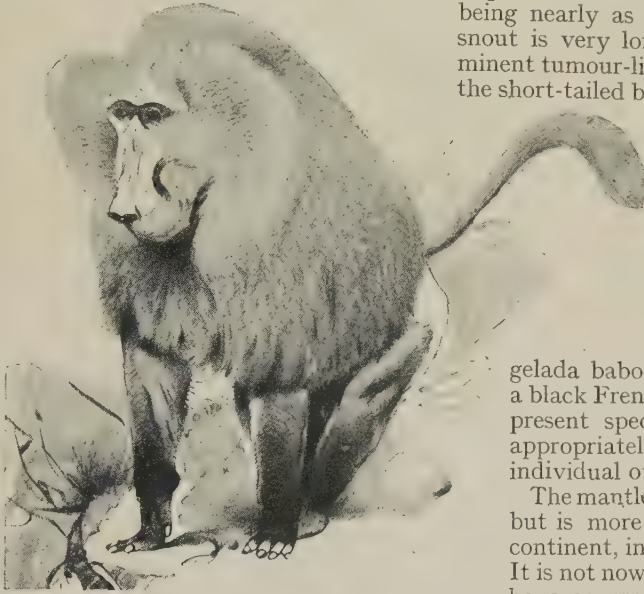
ject somewhat in front of the plane of the upper lip, like those of a dog, and are similarly divided by a vertical furrow. The eyes are surrounded by light-coloured rings, and the whiskers are brushed back so as to cover the ears. If the

gelada baboon be rightly compared to a black French poodle, the males of the present species might still be more appropriately likened to a grey individual of the same breed.

The mantled baboon inhabits Arabia, but is more common on the African continent, in Abyssinia and the Sudan. It is not now found in Egypt, but may have occurred there in ancient times; although, on the other hand, it is

quite probable that it may have been imported by the ancient Egyptians from the Sudan. The typical, Abyssinian representative of the species is much larger than the Arabian race, which is distinguished as *P. hamadryas arabicus*.

Among the ancient Egyptians this baboon occupied a prominent place in the long series of sacred animals, and was consecrated to the god Thoth. When sculptured by itself, it is the male that is represented, and it is always placed in a seated position, with the hands resting on the knees, the mane investing the body like a huge cloak. Her-mopolis, the city of Thoth, was especially devoted to the cult of these animals; while in Thebes a special necropolis was arranged for the preservation of their mummified bodies. In spite, however, of its sacred character, the ancient Egyptians, if we may trust their sculptures, were not averse from making use of the sacred baboon in the ordinary affairs of life. For instance, a bas-relief represents a fruit-bearing sycamore, in the branches of which are three monkeys, which from their long snouts, well-developed tails, and thickly-haired shoulders and necks, may be at once recognised as mantled baboons. On either side of the tree are two slaves, with baskets laden with sycamore figs, others of which they are receiving from the hands of the baboons. It thus appears that the ancient Egyptians had succeeded in training these intractable animals to gather fruit and hand it to their masters, precisely after the fashion that the modern Malays are said to have trained langurs in Sumatra to perform a similar kind of service; the fruit in



THE MANTLED BABOON

the one case being sycamore figs, and in the other coco-nuts.

The food of this baboon consists mainly of small fruits, berries, and seeds; although young shoots and buds of trees form a portion of its diet. Like the rest of its kind, it avoids forests and trees, and keeps mainly to the open country, preferring rocky spots. When it climbs, and it does so in a heavy ungainly manner, very unlike the active movements of the generality of monkeys. Its movements, when on the ground and in a hurry, partake more of the nature of a steady gallop than of the bounding motion of other monkeys. The association of these baboons in large troops is doubtless for the purpose of mutual protection. The old males are sometimes said to threaten men, and there is one well authenticated instance of a troop combining to attack a leopard which had carried off one of their number.

Writing of his experiences in the Egyptian Sudan, Sir Samuel Baker observes: "Troops of baboons are now exceedingly numerous, as, the country being entirely dried up, they are forced to the river for water, and the shady banks covered with berry-bearing shrubs induce them to remain. It is very amusing to watch these great male baboons stalking majestically along, followed by a large herd of all ages, the mothers carrying the little ones upon their backs, the latter with a regular jockey-seat riding most comfortably, while at other times they relieve the monotony of the position by sprawling at full length and holding on by their mother's back hair. Suddenly a sharp-eyed young ape discovers a bush well covered with berries, and, his greedy munching being quickly observed, a general rush of youngsters takes place, and much squabbling for the best place ensues among the boys; this ends in great uproar, when down comes a great male, who cuffs one, pulls another by the hair, bites another on the hind quarters just as he thinks he has escaped, drags back a would-be deserter by his tail and shakes him thoroughly; and thus he shortly restores order, preventing all further disputes by sitting under the bush and quietly enjoying the berries by himself."

THE CHACMA BABOON

The mantled baboon is an inhabitant of the countries bordering on the Red Sea littoral and the Upper Nile valley, but to reach the habitat of the chacma, or pig-tailed baboon (*P. porcarius*), it is

necessary to travel to the southern extremity of the African continent. The name chacma, it may be observed, is a somewhat euphonised rendering of the word t'chackamma, by which the Hottentots of South Africa designate this hideous baboon.

Like all the remaining representatives of the long-tailed baboons, the chacma differs from the mantled baboon in the absence of the mane on the neck and shoulders of the males. There exists, indeed, in this respect a gradual descending series from the gelada baboon, in which both sexes are maned, through the mantled baboon, in which only the males are so ornamented, to the chacma, in which both males and females are maneless. In size the chacma is one of the largest of the group, and it has been compared in this respect, as well as in its bodily strength, with an English mastiff.

The general colour of this animal is greyish black; but there is often a kind of greenish reflection in the fur when seen in certain lights. The head, as well as the hands and feet, is deep black, but the small whiskers on the sides of the face, which do not conceal the ears, are greyish. All the hair of the body is comparatively long and shaggy, while that on the nape of the neck, more especially in old males, forms a slender crest. The roots of the hairs are dun-coloured, but their extremities are ringed. The tail differs from that of the mantled baboon in the absence of any distinct tuft at the end. The muzzle



THE MANTLED BABOON

is perhaps even more prolonged than in the last-named species; but the nose is similarly extended beyond the upper lip. The naked callosities on the buttocks are smaller than is generally the case among the baboons. The bare part of the face is of a purplish hue, with the exception of a white ring round each eye, and the whole of the upper eyelids, which are also white. In the latter point, curiously enough, this species resembles the African mangabey monkeys (page 226). Like the other members of this group, the chacma carries its tail at first curved somewhat upwards, and then hanging straight down. The chacma is essentially a dweller in mountainous tracts, and is found in all the ranges of the Cape district, such as the Sneeuwberg and the Drakenberg. How far it extends northwards it is difficult to ascertain, since travellers and sportsmen are, as a rule, reticent on the subject of monkeys and their kindred. In Abyssinia the species is represented by the closely allied doguera baboon (*P. doguera*), often called the Abyssinian chacma, which is much lighter-coloured than the Cape species.

THE TRUE BABOONS

A female baboon allied to the last has been named *P. lydekkeri*; its hair, like that of *P. doguera*, being not ringed with different colour. The Abyssinian chacma collects in large droves to raid the cornfields.

Mrs. Annie Martin, in "Home Life on an Ostrich Farm," gives a most excellent description of the habits of the chacma in the Cape district. "On mountain excursions," writes this lady, "you frequently hear his surly bark, and sometimes see him looking out defiantly at you from behind a rock or bush, where possibly you have disturbed him in the midst of an exciting lizard-hunt, or careful investigation of loose stones in search of the centipedes, scorpions, and beetles hidden beneath. These creatures, uninviting though they appear to us, are among his favourite dainties, and he catches them with wonderful dexterity. In the silence of night his voice is so distinctly audible from the homestead that you would imagine him to be close by, though in reality he is far off in one of the kloofs of the mountains. One night, as we strolled up and down near the house, enjoying the bright moonlight, a loud chorus of distant baboons to which we were listening was suddenly interrupted, evidently by the spring of a hungry leopard, the moment's silence being followed by the agonised and prolonged yells of the victim. . . . No vegetable poison has the slightest effect on the baboon's iron constitution; and, indeed, if there exists any poison at all capable of killing him, it is quite certain that, with his superior intelligence, he would be far too artful to take it; and when the fiat for his destruction has gone forth, a well-organised attack has to be made on him with dogs and guns. He can show fight, too,

and the dogs must be well trained and have the safety of numbers to enable them to face him; for in fighting he has the immense advantage of hands, with which he seizes a dog and holds him fast while he inflicts a fatal bite through the loins. Indeed, for either dog or man, coming to close quarters with Adonis, as the chacma is ironically called by the Boers, is no trifling matter. One of our friends, travelling on horseback, came upon a number of baboons sitting in solemn parliament on some rocks. He cantered towards them, anticipating seeing the ungainly

beasts take to their heels in grotesque panic; but was somewhat taken aback on finding that, far from being intimidated by his approach, they refused to move, and sat waiting for him, regarding him the while with ominous calmness. The canter subsided into a trot, and the trot into a sedate

walk, and still they sat there; and so defiant was the expression on each ugly face that at last the intruder thought it wisest to turn back and ride ignominiously away."

The most general food of the chacma is afforded by the bulbous roots of an iris-like plant, known as *ixia*, of which there are several South African varieties, one of which is specially known as the baboon's *ixia*. These bulbs the chacmas dig up with their strong hands, and carefully peel before eating. Other kinds of bulbous and tuberous roots are also eaten by these animals; while buds and young twigs form a less important part of their food. In addition to this vegetable diet, the chacmas also search for and devour various kinds of insects, especially locusts, and also allied animals, such as scorpions; the latter being carefully deprived of their stings before being consumed. Lizards and frogs are dainties less commonly eaten; while birds' eggs, together with various worms and grubs, practically complete the chacma's bill of fare.

These baboons are well represented in menageries, where they thrive well. When young they are fairly tractable, but their temper steadily deteriorates with advancing age.

THE ANUBIS BABOON

The anubis baboon (*P. anubis*), together with the two following species, may be distinguished from the chacma by the fact that the hairy parts of the hands and feet are much darker than the legs and back, instead of both feet and legs being of the same dark hue.

The general colour of the present species is olive

green, whence it is sometimes known as the olive baboon. There is a small crest on the nape of the neck, and the hairs are grey near the roots, and ringed with black and yellow at the tips, while the face is dusky in colour. The typical locality of this baboon is Guinea, but it appears to extend across the continent to East Central Africa, where it is represented by a local race known as *P. anubis neumanni*, distinguished by the great development of the ridges on the upper jaw.

In habits these baboons appear to be very similar to the other species of the genus. They associate in

large troops, and inhabit rocky mountainous regions, being especially common at the Black Rocks, some two hundred miles in the interior of Angola. Away from the river valleys the country is arid in the extreme, and these thirsty districts are the chosen abode of the baboons. Here they subsist largely



YOUNG CHACMA BABOON AND YELLOW BABOON

Photograph by W. P. Dando



THE ANUBIS BABOON

on that remarkable West African plant known as the welwitschia. Indeed, so extraordinary is this plant that it is worth a brief description. The welwitschia, in its earlier stages, consists of two ordinary seed-leaves. These grow considerably and extend horizontally outwards in opposite directions, raised but little above the surface of the sand; while the intervening stock thickens and hardens, assuming a somewhat conical shape, flattened at the top, and rapidly tapering below into the roots. In time the original pair of seed-leaves, having attained their full size and acquired a hard and fibrous structure, instead of dying, gradually split up into shreds; at the same time the woody mass upon which they are borne, although rising but little in height, increases in width both below and above the insertion of the leaves, so as to clasp their bases in a deep slit on the margin. Every year several short flowering stalks are developed from the upper side of the base of the leaves. Each of these stalks forms an erect jointed stem, dividing in a fork-like manner, varying in height from six to twelve inches, and carrying at the end of each branch a cone, with the flowers and seeds beneath its scales. The result is that the country is studded with these tabular or anvil-like masses of wood, whose flat tops, pitted with the scars of old flowering-stems, never rise to more than a foot above the ground, but vary, according to age, from a few inches to upwards of five or six feet in diameter. Even those which are not more than 18 in. in diameter are supposed to be fully a century old, although still retaining their original seed-leaves, which, albeit torn and tattered by the wear and tear of time, are,

when entire, fully six feet in length. It is upon the stems and exposed portions of these extraordinary plants that the anubis baboons feed, tearing and ripping the woody tissue with their powerful tusks.

THE YELLOW BABOON

The yellow baboon (*P. cynocephalus*) may be distinguished from the anubis by the absence of a crest of hair on the nape of the neck and by its colouring. It takes its popular name from the pale brownish yellow hue of the fur, which is rather darker on the sides of the back than elsewhere, while it tends to a whitish tint on the cheeks. The hair on the crown of the head is somewhat elongated. Unlike the anubis baboon, the hairy parts of the hands and feet are of the same yellowish colour as the legs and body, while the face and other bare parts are flesh-coloured.

It was long thought that the yellow baboon came from Nubia and the Sudan, but it is now known to occur on the west coast. Writing of a baboon from the Kilimanjaro district, provisionally, but perhaps incorrectly, identified with the yellow species, Sir H. H. Johnston observes that these baboons generally frequent the outlying parts of the plantations of the natives, subsisting largely on the maize and other products stolen therefrom. In certain localities they are extremely numerous, going about in troops composed of from about fourteen individuals of both sexes and all ages. They have little fear of man, and instead of running away will turn round and face an intruder, with threatening gestures, at a distance of only a few yards. The natives are in the habit of driving them away from the crops, when the baboons retreat in a leisurely manner, with their cheek pouches crammed full, and often dragging off some of the plunder in their hands. In one instance it is related that a troop of these animals pursued a native lad for some time, until he had placed a river between himself and his pursuers.

The Thoth baboon (*Papio thoth*), of Abyssinia, agrees with the yellow species in the livid flesh-colour of the face, as well as in the absence of a long crest of hair on the nape, and may indeed be only a local form of that species.

THE GUINEA BABOON

There are few species of mammals that have given rise to more confusion in natural history literature than this, of which examples have been described under at least two distinct names and regarded as different species, though it is a well-ascertained fact that the common baboon, or papio, belongs to one and the same species as the sphinx, or Guinea baboon (*P. sphinx*).

The Guinea baboon is characterised by the uniformly reddish brown colour of its fur, which is washed with a yellowish tinge, more especially on the head, shoulders, back, and limbs; the cheeks and throat being paler, and the whiskers fawn-coloured. The naked parts of the face are bluish black, and the hairy parts of the hands and feet are much darker than the legs and back. The

THE MANDRILL

nose projects rather beyond the upper lip, but is somewhat less elongated than in the chacma, and has small swellings corresponding with those so enormously developed in the mandrill. It is the smallest of all the baboons and is frequently carried about by showmen. As its name implies, it is a native of Guinea, and large numbers are imported into Europe.

THE MANDRILL

The mandrill (*Maimon mormon*) brings us to the first of two West African species of baboons distinguished from those hitherto considered by the reduction of the tail to a short stump, and also by the long tuberculous swellings on each side of the muzzle, which communicate the peculiarly ugly expression to the face. Moreover, the whole head is larger in proportion to the body than in other baboons, and as the fore quarters also appear to be relatively higher in proportion to the hind parts, the general appearance is ungainly in the extreme. In fact, the whole aspect is far more suggestive of the forms imagined during a nightmare than is the case with any other living mammal (page 209).

Many years ago it was suggested that these two species ought to be separated from all the other baboons, and placed in a genus by themselves; and although this view did not at first meet with general acceptance, there is little doubt but that it should be adopted. It is true that, as compared with ordinary baboons, the small size of the tail in the drills is merely analogous to the condition which obtains in certain members of the macaque monkeys, while the huge swellings on the face are only exaggerated developments of the smaller ones found in the Guinea baboon, but the general form of the short-tailed baboons is sufficient to justify the proposed separation.



GUINEA BABOONS
Photograph by W. S. Berridge

The mandrill is one of the largest of baboons, and is, in truth, a brute of tremendous power and ferocity. Its leading characteristics are to be found in the facts that the short and tuberculous tail has its under surface naked, and that the swellings on the face are ornamented with a brilliant colouring in the adult male, and are of enormous dimensions.

From the great development of these swellings on the sides of the muzzle, the English naturalist Thomas Pennant (1726-1798) gave to the mandrill the name of rib-faced baboon, but this has generally been discarded by modern writers in favour of the former term. Here it may be mentioned that the word "mandrill" signifies "man-like baboon," the term "drill" being an old English word of which one meaning denotes "baboon," or "ape."

The limbs of the mandrill are characterised by their relative shortness and powerful build, and in correlation with these the form of the body is likewise powerful and robust. The ugly and massive head has scarcely any distinct forehead, the profile sloping almost uninterruptedly upwards from the muzzle to the occiput.

The nose, instead of projecting in front of the upper lip, as in the mantled baboon, is somewhat truncated; while the projecting eyebrows and deeply sunk eyes communicate a forbidding expression to the whole countenance. The tubercular swellings on each side of the muzzle are supported on ridges arising from the swollen bones of this part of the skull, and are themselves almost the size of a man's fist. As a whole, they are somewhat sausage-shaped, and are marked with a series of prominent transversely disposed ribs of light blue, with deep purple in the



THE YELLOW BABOON

grooves, while the middle line and the tip of the nose are brilliant vermillion. The contrast between such brilliant colours and the general hue of the fur and the hazel eyes is most marked. The stump of a tail, which is naked on the under side, is carried erect and bent over the back somewhat after the manner of that of a pug dog. The general colour of the fur is a blackish olive, darker on the crown of the head, the middle line of the back, the nape of the neck, and the flanks, and lighter on the cheeks. The summit of the head is crowned with a crest of dark hair directed backwards in a pointed and peaked form, while the chin is ornamented with a small pointed beard of an orange-yellow colour. The long hair of the under parts in old males is white. To add to the strange effect of all these varied tints, the large naked callosities on the buttocks are of a bright blood-red colour. The pointed crest on the crown gives to the whole head a somewhat triangular form, and, in harmony with this peculiar contour, the naked bluish black ears are angulated at their fore-and-aft borders, suggesting the appearance of having been cropped. The truncated muzzle is surrounded by a raised border like that of the swine, from which circumstance it has been considered by some writers that the mandrill is the problematical animal alluded to by Aristotle as *Chæropithecus* ("hog-ape"), but this identification is by no means certain.

Such are the colours of the adult male mandrill, but the brilliant scarlet of the middle and end of the muzzle is not assumed until the first, or milk, teeth have been replaced by the permanent series, while, at a still younger age, the whole of the face is black. Moreover, it is only in the adult of the male sex that the swellings on the sides of the snout assume the enormous dimensions above noticed. Both in the young males and in the females of all ages these swellings are only of moderate dimensions, and in the female they are coloured plain blue. In correlation with the smaller size of the fleshy swellings, the skulls of females and young males are characterised by the much slighter development of the bony ridges underlying these structures, which form such prominent features in the skulls of old males.

In the wild state on the western coast of Africa mandrills have habits very like those of other baboons, living in large troops, and, on this account, as well as from their size and strength, being exceedingly formidable antagonists. The accounts given by the earlier travellers of their attacking men without being provoked require to be confirmed; and we are in want of full information as to their habits in general.

In confinement, the chief characteristic appears to be that the ferocity and moroseness common to the old males of all baboons is intensified. There is also a marked liking for spirituous liquors, which is likewise a trait exhibited by other species of the genus. One of the earliest examples of an adult male mandrill exhibited in London was the famous "Jerry," immortalised by Mr. W. J. Broderip, which

was kept first in the menagerie at Exeter 'Change, in the Strand, and then transferred to the Surrey Zoological Gardens, on the southern side of the Thames. This animal had learnt to drink daily a pint of porter, which he seemed thoroughly to appreciate, and he had also been taught to smoke tobacco in a short clay pipe, although this accomplishment did not appear to be so much to his taste.

Of late years the mandrill has often been represented in the Zoological Society's Gardens in Regent's Park. An extraordinary animal was born in the Society's menagerie in the autumn of 1878, being a female hybrid produced by a cross between a female mandrill and a male of the crab-eating macaque (*Macacus cynomolgus*).

The mandrill is strictly confined to the tropical parts of West Africa; the Gabun district being, perhaps, its headquarters.

THE DRILL

Although described by Frédéric Cuvier so far back as 1807 as a distinct species, the baboon known as the drill (*Maimon leucophaeus*) had for many years before, in spite of a figure given by Pennant, been considered to be merely the young of the mandrill which had not acquired the characteristic colouring of the face. The acquisition of adult specimens of the drill by museums and menageries proved, however, the correctness of the English and French naturalists' determination. It is exclusively West African, but its range in latitude appears to be somewhat more extensive than that of the mandrill.

The drill may be distinguished from its larger cousin the mandrill by the absence of bright colours on the naked parts of the face, which are entirely black. The short tail is covered with hairs over the whole of its surface, while the general build, and especially that of the limbs, is of a much more slender type. Again, although the face has the long sausage-like swellings of the mandrill, these are considerably smaller and less inflated. The drill is ugly enough, but it is one degree less repulsive than the male mandrill.

The general colour of the fur is brown, tending to a whitish tint on the forehead and the crown of the head, and darker on the shoulders and limbs. The under parts are also lighter, being either of a pale brown or a silvery grey tint. The hair of the upper parts is very long and fine, and is of a light brown colour at the root, but ringed with black and yellow at the tips; these rings of two colours giving a greenish tinge to the fur when seen under certain lights. The whiskers are thin, and directed backwards like those of the mandrill; and the drill also resembles that species in the peaked crest on the crown of the head, as well as in the small yellow beard beneath the chin. The apology for a tail terminates in a small tuft of hair. The naked face and ears present a jet black appearance, and the swellings on the snout are not marked by the oblique transverse furrows and grooves which characterise those of the mandrill. The naked portions of the

EXTINCT BABOONS

hands and feet are copper-coloured, while the bare callosities on the buttocks are bright red. The colour of such portions of the skin as are covered with hair is of a uniform dark blue. The female drill is distinguished from her lord by her smaller size and the relatively shorter head and paler colouration, in which the young males resemble her.

Nothing is known of the drill in its wild state. In confinement, however, its habits are very similar to those of the mandrill, and doubtless there is the same similarity in the wild condition. Of late years it has been found that representatives of most of the mammals of the West Coast extend through the forest-zone to East Africa; but the mandrill and drill, like the gorilla, appear restricted to the former area.

With the drill is concluded the notice of the living monkeys of the Old World; but, before passing to those of the New World, a short space may be devoted to a few extinct baboons.

EXTINCT BABOONS

The survey of the long series of Old World monkeys has shown that as we pass from the man-like apes through the true monkeys to the baboons, we have been gradually receding farther and farther from a marked approximation to the human type, until we reach forms that show a decided resemblance in their projecting muzzles and general contour to the lower orders of mammals. These lowest forms being the baboons, it is but natural to assume that they are likewise old in the history of the animal kingdom, so that we should expect to find them in a fossil state. In Europe, however, no traces of fossil baboons have yet been discovered; while in Africa we only know of them as occurring in the superficial deposits of Algeria. The latter circumstance must not, however, be taken as an indication that other species of fossil baboons will never be found in Africa, since our knowledge of the geology of the greater part of that continent is of the most limited nature. At present it is only in the extreme north of India that evidence of the existence of fossil baboons belonging to a period antecedent to that during which man has existed on the globe has been obtained. And it is in the sandstones forming the outer flanks of the mighty Himalaya, which contain the remains of the extinct Indian chimpanzee and orang-utan, that those of the fossil baboons occur. These rocks, as already stated, belong to the Pliocene division of the Tertiary

period. The remains of the Pliocene Indian baboons are, like those of all the primates, extremely few, yet they are sufficient to prove the existence in that country of two distinct species. Both of these appear to have been closely allied to some of the long tailed African species; and it may therefore be concluded that the Indian species were allied to the mantled baboon or the chacma. There is, moreover, evidence that baboons continued to exist in India until either the early human or Pleistocene period, since a single tooth has been obtained from deposits in a cavern in Madras which has likewise yielded remains of man.

These and the aforesaid remains of man-like apes afford decisive proof that at a former epoch of the earth's history such an assemblage of primates was gathered together on the plains of India, at a time when the Himalaya did not exist, as has been seen nowhere else beyond the walls of a menagerie.

Side by side with langurs and macaques closely resembling those now found in that region were chimpanzees and baboons as nearly related to those of modern Africa; while the extinct Indian orang-utan recalls the existing species of Borneo and Sumatra. India, therefore, in the Pliocene period, may perhaps have been the central point whence the main groups of Old World primates dispersed to their far-distant homes.

The generalised character and the large size of the baboons have suggested that we should look to them as the original ancestral stock from which the man-like apes took their rise. There is, however,



THE MANDRILL

found in strata of the Lower Pliocene period of Europe a baboon-like ape known as the mountain ape (*Oreopithecus*), which combines to a certain extent the features now characteristic of the man-like apes and the baboons. It is this monkey, therefore, which has more claims to be regarded as near akin to the ancestral stock of the man-like apes; the baboons being survivors from a still older stock, from which the mountain ape was itself derived. On the other hand, as mentioned in an earlier page (201), remains of gibbons and man-like apes occur in Pliocene strata; a fact pointing to a still earlier separation of the two groups, which may have been independently derived from lemur-like creatures. In this connection it may be stated that Dr. A. Keith has expressed the opinion that the gorilla and chimpanzee are co-descendants of an early Miocene ape, for which the name *Protroglodytes* is suggested. It is estimated that more than five million years have elapsed since the separation of the human stock

as a distinct type; the body having probably been adapted to the upright posture before the close of the Miocene period, while development during the Pliocene and Pleistocene epochs has, in this naturalist's opinion, been mainly restricted to brain-expansion.

R. LYDEKKER

STORIES OF THE BABOONS

Although the baboon has so black a reputation as thief and savage, he has some redeeming features. His amiability does not always vanish with his youth. Doubtless, temperament varies in baboons as it varies in men and other animals. Hence, while it would be unwise to expect good nature in all baboons, it would be equally unjust to condemn the whole family as implacably ferocious. True, one nearly killed a keeper at the Zoological Gardens in London; but another, an anubis baboon, which still flourished in 1909 in the same gardens, was so docile and trustworthy that it was successfully subjected to a ticklish operation. In a fight it had sustained a badly lacerated arm. Possibly to-day, now that the hospital at the Zoo includes a chamber for administering anæsthetics, the creature would be chloroformed before the surgeon operated. As it was, the keeper and the baboon were on such excellent terms that the man was able to hold the injured limb while the surgeon cleaned, stitched, and dressed the wound.

Herr Schillings had a tame baboon, a big and powerful creature, when he was out in Africa, and it was this animal which always sighted him as he returned after some long journey. "His sight is infinitely keener than man's," says the traveller, and though the natives are blessed with powers of vision to which Europeans are strangers, the baboon's eyesight was as much superior to theirs as theirs to ours. When his master was still but a speck upon the horizon the baboon would see him, and, "almost mad with joy," would be the first to give the signal.

The keen-sighted baboons which haunted the defences of beleaguered Ladysmith, it will be remembered, were always the first to apprise the British garrison of an advance of the Boers. But Herr Schillings knew another baboon which also displayed a lively sense of the dangers of war-time. He was chained up at the entrance to the fort at Moshi, where his chief human friend was a little negro child, with whom he played every day in the drollest fashion. The baboon was at his post one night when the garrison was expecting an attack. Suddenly the inhabitants of the station poured into the fort. The baboon, sharing their fears, managed to break loose, and was one of the party which rushed for protection into the stronghold.

The memory of the baboon for its friends is not short-lived, for we have it from Sir Andrew Smith that one recognised him with joy after an absence of nine months. The same exact observer gave Darwin another instance of the baboon's memory, this of a very different character. The animal had been plagued by a certain officer, and one day,

seeing him approach, poured water into a hole and hastily made some thick mud, which it skilfully dashed over the officer as he passed by, to the infinite amusement of the onlookers. For long afterwards the baboon rejoiced and triumphed whenever he saw his victim.

A human weakness discovers itself in the baboon's liking for strong drink; but usually, after the miseries consequent on one debauch, the baboon rises superior to the temptation. Brehm saw captive baboons which were under the influence of liquor. On the following morning they were dismal and morose; they held their aching heads with their hands, and wore a most pitiable expression. When beer or wine was offered them, they turned away with disgust, but relished the juice of lemons.

The baboon, when not captive, does not easily succumb to the influence of liquor, even when poison is added. An experience of Herr Windhorn in 1906 goes to confirm the statement of Mrs. Martin (page 243) as to this animal's immunity from vegetable poison. Herr Windhorn was bringing over a number of animals in the Comrie Castle, when a powerful baboon escaped from its cage into the hold of the vessel. Though shut off from the deck the baboon defied all attempts at capture for two or three days. Then Herr Windhorn and a keeper attempted to catch it with nets. These the ape eluded, clearing the obstacles by tremendous leaps, fifteen feet at a time. Herr Windhorn ventured at last into the hold, but tripped over one of the nets and fell. Instantly the baboon sprang upon him, and made its terrible teeth meet through one of his legs. He struggled to beat off the animal, but it seized him by the hand, and badly mutilated that limb. The keeper, assisted by the boatswain, came to the prostrate man's assistance, and both were severely bitten before they succeeded in making their escape with him from the hold. After this, a bottle, containing half a pint of whisky and opium, "enough to poison ten men," was lowered into the hold. The baboon swallowed the mixture without showing the least ill result. Eventually it was captured by a trick. Lured to a grating by a display of fruit, it put its hands between the bars to reach the food, and they were lassoed and bound, and the baboon was carried to its cage. After four days of renewed captivity, however, the animal died, "broken-hearted at being mastered," said its owner.

Herr Schillings pays his tribute to the skilful organisation of the baboons for the detection of enemies, and mentions that, fearing the appearance at their drinking-places of their dreaded enemy, the crocodile, they never drink without having the water watched and guarded by some veteran of the troop. At the first suggestion of danger the whole troop rush to safety, and do not descend until from their watch-towers the old baboons see that the course is clear. Very often they will all proceed to some shallower spot where it is more difficult for a crocodile to reach them. Herr Schillings says, in his "Flashlight and Rifle," that to him "it seems a fact that baboons have a

STORIES OF THE BABOONS

language of their own, and that in danger the old animals give their commands by means of some simple method of speech."

Herr Hagenbeck, in his "Beasts and Men," seems to incline to the like belief. Describing the capture of baboons in a hut furnished with a spring door, he says that the herd outside surround the prisoners and urge them to escape. When the captives are taken away, their comrades do not desert them, but climb the palm trees and howl out unintelligible words, which are answered with mournful cries by the prisoners. Herr Hagenbeck adds a startling story of a successful raid by three thousand powerful Arabian baboons upon a party of hunters who had captured a number of these animals. Sheer weight of numbers routed the captors, armed though they were with firearms, and the victorious baboons soon made short work of the cage, and released their imprisoned friends.

If experience does not teach, intuition, if the word may be used, serves the baboon very well. Frank Buckland had an experience with one which bears upon the point. The baboon which he kept while living with his father at the Deanery of Westminster escaped one day from her pole, and darted off, carrying her chain with her. Away she went, over the roofs, with Buckland courageously following. Although her attention was distracted by the crowds of people gathered in the streets below, she managed to elude her pursuer every time he drew near. Her flight carried her to the roof of a house from which her chain hung down in front of a window at which a woman was standing. Buckland made no sign, but said quietly to the woman: "Please put out your hand and catch hold of that chain." Before the woman could make the attempt the animal anticipated her, and, drawing up her chain, hand over hand, as a sailor hauls a rope, was off again. "This is curious," remarks Buckland, "because I was careful to make no motion or sign of my intentions, and merely spoke the words. The animal seemed to understand what I said, for she hauled up her chain even before the woman put her hand out of the open window to catch hold of it." Eventually, when the truant had run to the end of the houses in Dean's Yard, she made a terrific leap on to some leads below, and, dashing off for home, made straight to her pole again, as if now satisfied to return after defeating all attempts to capture her.

It is a much disputed point whether any animal has sense enough to set a bait to catch its prey. Romanes had no doubt that a dog-headed baboon, which he watched, set a snare for an anubis baboon in an adjoining cage. In the one cage were the Arabian baboon and an anubis baboon; in the next, a solitary dog-headed baboon. The anubis baboon passed its hand through the wire partition to reach a nut which the watcher believed to have been deliberately left as a bait by the big dog-headed baboon. "The anubis baboon knew perfectly well the danger he ran, for he waited until his bulky neighbour had turned his back upon the nut, with the appearance of having forgotten all about it.

The dog-headed baboon, however, was all the time slowly looking round with the corner of his eye, and no sooner was the arm of his victim inside the cage than he sprang with astounding rapidity and caught the retreating hand in his mouth. The cries of the anubis baboon immediately brought the keeper to his rescue, when, by dint of a good deal of physical persuasion, the dog-headed baboon was induced to leave go his hold."

There seems in that a strong case for those who maintain that certain animals learn to lay snares. The after proceedings were particularly interesting. The injured baboon retired to the centre of its cage, moaning piteously, and holding the damaged member against his chest, while he rubbed it with the other. Its companion, the Arabian baboon, now approached him from the top of the cage, and, while making a soothing sound very expressive of sympathy, folded the sufferer in its arms, exactly as a mother would her child in similar circumstances. Romanes adds that this expression of sympathy had a decidedly quieting effect upon the sufferer. His moans became less piteous as soon as he was enfolded in the arms of his comforter; and the manner in which he laid his cheek upon the bosom of his friend was as eloquent as could be of sympathy appreciated.

There was at one time a chimpanzee at the Dresden Zoological Gardens which found great satisfaction in setting a bait for a little mona monkey which occupied the adjoining cage. Here, however, there was no sinister motive behind the trick; the intention was only to tease. The ape would plant a biscuit near the netting where the monkey, by putting its arm through, could reach it. But every time that the monkey approached to seize the lure, the ape would snap it up in triumph. Once when the monkey, tired of the teasing, had retired to the other side of the cage, the chimpanzee put the biscuit through, and the monkey got it. Thereupon the ape seized the wires and shook them, and pouted with vexation like a child.

The baboon is a good hater, as we have seen. He will when young make friends with a host of people, but if one offend him he does not forget or forgive. He takes offence at trivial things, and broods over them like a sulky child. A little thing gave mortal offence to a great baboon which some years ago flourished in the Dublin Zoological Gardens. Its special favourite was Dr. Ball, the superintendent, who always made a point of paying it a visit, and petting it whenever he was near. One day, however, when showing the lord-lieutenant round the gardens, he was too much occupied when in the monkey-house to pay his customary visit to the baboon. When next Dr. Ball went to the cage the baboon would not take any notice of him, and refused to resume the old friendly relations until illness came upon it. Consumption seized it, and in spite of every care the animal grew worse and worse. The day before it died, seeing Dr. Ball, it crawled to the front of its cage, and held out its paw to him in token of reconciliation.

E. A. B.

AMERICAN MONKEYS

THE monkeys of Tropical America differ so remarkably from those of the Old World that they cannot be included in either of the families already treated of. The ordinary monkeys of the New World form, indeed, a perfectly distinct family by themselves, known as the Cebidæ. In addition to these, there is another group of American primates called marmosets, which, although nearly related to the Cebidæ, constitutes a second family.

The better-known representatives of the ordinary monkeys (Cebidæ) of the New World are popularly designated howlers, spider monkeys, sapajous, and titis, to which alone the term "American monkeys" should be restricted. In regard to the characters by which these monkeys are distinguished from their cousins of the Old World, it may be mentioned in the first place that no New World monkey has naked callosities on the buttocks. This character will at once serve to distinguish any American monkey from all those of the Old World except the larger man-like apes, with which there is not the slightest fear of its being confounded. Then, again, all the monkeys of the New World are characterised by the absence of cheek pouches; so that whenever a monkey is seen cramming nuts into his cheeks we may be perfectly sure that he does not come from America. It is true, indeed, that this absence of cheek pouches will not help us to distinguish an American monkey from an Indian langur or an African guereza monkey, but then both the latter have naked callosities on the buttocks. Moreover, if we were to dissect an American monkey it would be found that it had a simple stomach, quite different from the sacculated one which characterises the langurs and guereza monkeys.

Another peculiarity of some, although by no means all, of the American monkeys is that the tail is prehensile, and capable of being coiled round a bough so as to form a most efficient aid in climbing. These prehensile tails are characteristic only of the howlers and the spider monkeys, and their kin; the tails of the titis and their allies being non-prehensile, like those of Old World monkeys. The reader may note, however, that whenever he sees a monkey swinging suspended by its tail, he may at once put that animal down as an American.

A more important feature of the American monkeys, as being common to the whole of them, is the great width of the vertical partition between the two nostrils, of which mention has already been made (page 35). This partition causes the end of the nose to be expanded; and a comparison of

full-faced figures of New World monkeys with those of the Old World will show the marked difference in this respect between the two groups.

Another important character is that in those of the American monkeys which are furnished with a thumb, this digit cannot be opposed to the other digits of the hand. The American monkeys agree, however, with their cousins of the Old World in having all their digits provided with well-developed nails.

The most important and perfectly constant distinction between the monkeys of the Old and New World can only be observed in the skulls. In the monkeys of the Old World the total number of teeth is thirty-two; but if we examine the skull of any American monkey (excluding the marmosets) and count the teeth, we shall find that their total number is thirty-six. A closer examination will show that the additional tooth on each side of both jaws belongs to the premolar series—the so-called bicuspid of human dentistry. Thus, whereas all Old World monkeys have but two bicuspid on each side of both the upper and lower jaw, the American monkeys have three of these teeth; and the number of teeth in the latter may accordingly be expressed by the formula $i.2, c.1, p.m.3, m.3$; total, 36.

If we care to carry our examination a little further, it will not fail to be noticed that the upper molar teeth of the American monkeys differ very decidedly in the form of their crowns from those of the monkeys of the Old World, so that a single detached specimen of one of these teeth is amply sufficient to decide to which of the two groups its owner belonged. Thus, whereas in the

Old World monkeys, exclusive of the man-like apes, the crowns of these teeth are tall and narrow, with the four tubercles arranged in pairs nearly at right angles to the long axis, and each tubercle nearly conical, in the monkeys of the New World the crowns of these teeth are much shorter and broader, with their pairs of tubercles arranged obliquely to the long axis; the outer tubercles being much flattened, and the inner crescent-shaped. Those acquainted with the details of anatomy will also find characters by which the skulls of Old and New World monkeys can be mutually distinguished.

A German naturalist, Dr. Hermann Klaatsch, has made the interesting discovery that, with the exception of the man-like apes, none of the Old World monkeys possesses a muscle corresponding with the one known in human anatomy as the short head of the *biceps flexor cruris*. And since the representative of the same muscle, under two



BROWN SAPAJOU
Photograph by Lewis Medland

THE SAPAJOU OR CAPUCHIN MONKEYS

different modifications, occurs in American monkeys, the question whether these are more nearly related to man and the man-like apes than are the ordinary monkeys of the Old World is opened up.

The headquarters of the American monkeys are the great forest regions of the lower Amazon valley, known as the selvas; although monkeys are also abundant in many other parts of Brazil, and likewise in the Orinoco valley in Venezuela. All these animals are truly tropical and subtropical, although they extend to a longer distance south of the equator than they do to the north. Northwards, indeed, monkeys do not extend beyond the Tropic of Cancer in the southern half of Mexico; whereas in South America they are known to range as far as the Rio Grande do Sul, in 30° S.

American monkeys are divided into ten distinct groups, the first of which includes:

THE SAPAJOUS

The long and prehensile-tailed monkeys commonly seen in menageries, and known respectively as sapajous or capuchin monkeys and spider monkeys, may be regarded as the typical representatives of the family Cebidæ; and, together with two other genera, constitute a group which can be easily recognised and distinguished from all their cousins. With the exception of the howlers, this group is indeed the only one furnished with prehensile tails; and, altogether apart from the question of voice and the presence of certain structures connected therewith, all its members differ from the howlers by their rounded heads and the nearly vertical plane of the face.

The sapajous (genus *Cebus*) may be distinguished from the other genera in this group by the fact that their tails, which are comparatively stout and of only moderate length, have no naked part on the lower surface of the extremity. In this respect they are not so perfectly adapted for the purpose of prehension as are those of the other genera. Another feature is that the hair does not partake of a woolly nature. Moreover, the general build of the body is rather stout, the arms and legs according in this



THE WEEPER SAPAJOU

respect with the body, and not being excessively long or excessively slender.

The native name of these monkeys on the Amazon is caiarara, or "macaw-headed," the word "arara" meaning "macaw"—caiarara being abbreviated frequently into cai; the name sajou or sapajou has been evolved by a curious modification, originally due to Buffon using the word sai (the equivalent of cai) for the weeper capuchin, and sajou for another species of the genus. The term capuchin takes its origin from the cowl-like appearance of the hair on the forehead of the species of that group.

The sapajous are represented by a large number of species, ranging from Central America to the south of Brazil. Our knowledge as to the real number of species is, however, still incomplete, as there is a great amount of individual and racial variation.

Together with the spider monkeys, the sapajous are the most docile and the most readily taught of all American monkeys, and, since they bear confinement and the European climate well, they are the commonest monkeys carried about by organ-grinders.

THE WHITE-CHEEKED SAPAJOU

The white-cheeked sapajou (*Cebus lunatus*) is an inhabitant of Brazil, characterised by the length of the hair on the head, which is directed backwards, while that round the face is longer, and curved so as to form a kind of crest on each eyebrow. On the cheeks the hair is short and flattened down. The fur of the body and head is long, soft, and silky, its general colour being blackish, but that on the cheeks and temples is yellowish white. It is this light hair on the cheeks that gives its distinctive name to the species. The head is relatively large.

THE BROWN SAPAJOU

In Guiana the sapajous are represented by a species known as the brown sapajou (*C. fatuellus*, page 250), which presents a variation, due either to differences of age or to individual peculiarity, in regard to the form of the hair on the head, which has led to the supposition that there were two distinct species. In one of these forms the hair on the crown of the head is nearly flat, and directed backwards, this form having been described as *C. apella*. In the other



SMOOTH HEADED SAPAJOU

type the hair on the sides of the crown of the head is lengthened, so as to form a pair of more or less distinct longitudinal crests, this type being hence known as the horned sapajou. It is in winter, when the fur is longest, that the crests of the horned variety become most prominent, these never making their appearance until the animal has cut its permanent canine teeth. Like that of its congeners, the disposition of this species in captivity is mild and affectionate.

Although subject to great variation in this respect, the general colour of the thick and rather harsh fur is reddish brown, becoming darker on the middle of the back, as well as on the legs and tail. The fore arms, together with a broad spot on the crown of the head and the whiskers, are nearly or quite black, while the front of the shoulders is yellowish. It is on either side of the dark spot on the crown of the head that the crests are situated in the horned variety. The face and other naked parts have a violet tinge.

THE SLENDER SAPAJOU

The slender or white sapajou (*C. flavus*) is a rare local species allied to the preceding, and inhabiting Bolivia in the neighbourhood of Santa Cruz. It is distinguished by the smaller size and lighter colour of the dark spot on the crown of the head, which is generally brown, and often has a small crest on each side. The general colour of the fur is fulvous or greyish fulvous, the limbs and tail being of a darker brown and the beard a golden yellow. There is also a nearly white variety. Bates, who alludes to the slender sapajou as the *caiarara branca*, heard of its reported existence in the forests of the Tapajos River, which flows into the Amazon from the Cordillera Goral, on the Bolivian frontier of Brazil. His search was, however, in vain; and he was afterwards informed that the species only occurred across the watershed in Bolivia.

Another nearly related monkey, more widely spread in South America, is the tufted sapajou (*C. cirrifer*), in which the general colour of the short fur is black, but yellowish white on the cheeks, chin, sides of the forehead, and a narrow band over the eyebrows. Two long, recurved tufts of hair, which often occur on the side of the head, give the distinctive name to this monkey.

A monkey known to the natives of the Lower Amazon valley as the *macaca prego* was provisionally identified with this species by Bates, who described it as frequenting the cultivated lands, where it commits wholesale depredations with the most unblushing effrontery. The worst of these thefts is that, from the hasty and random manner in which the fruit is broken and plucked, the creature wastes far more than it can eat. When about to return to its native forest, it carries away as much plunder as it can hold in its hands and under its arms.

THE WEEPER SAPAJOU

One of the most common species is the weeper sapajou, or capuchin (*C. capucinus*), of Brazil (page 251). It is characterised by the hairs on the crown of the head being short and directed evenly

backwards, without any tendency to form crests on the sides. The colour of the fur is brown, with a golden tinge, the side of the forehead, cheeks, throat, and chest, as well as the front of the shoulders, being pale yellow; while a black or dark brown line extends from the base of the nose to the back of the neck, gradually expanding as it goes backwards.

These sapajous have a wide range, extending across Brazil, from Bahia in the east to Colombia in the north-west. With the exception of the occasions when they descend to drink, their whole life is spent in the trees of those regions of the forest where there is no underwood. They generally live in small parties, numbering from about six to ten or twelve individuals, of which the majority are females. From their shy and timid habits they are very difficult to observe. Their cry appears to be limited to a kind of low whistle, which serves to attract attention to them.

When captured young, the capuchin is always easily tamed, but older animals refuse all food, become mopish, and do not survive more than a few weeks. The younger ones soon take to their masters, and exhibit remarkable fidelity. They are, however, more readily attached to coloured than to white people, and are generally very fond of other animals, so that in Paraguay it is a common custom to bring them up with a young dog, upon which they ride. To some persons they at once conceive a rooted dislike, which cannot be eradicated. Their intelligence is shown by the manner in which they learn to open an egg, most of the contents being lost at the first trial, but carefully secured at the second attempt. Although they flourish in captivity if well attended to, they must be protected from cold and damp. Their average term of life is about fifteen years.

Like most other monkeys, captive capuchins are the very spirit of mischief, and are also prone to theft, more especially of eatables. When detected in the act of stealing, they cry out before being touched; but if not caught they affect perfect innocence, going about as if nothing had happened. When disturbed, small substances are hidden in their mouths and afterwards consumed at leisure. They are extremely covetous, and this greed is taken advantage of to capture them. The negroes are in the habit of removing the pulp of some gourds through a small aperture, and then putting sugar inside; such prepared gourds are placed near the haunts of the capuchins, who come down, inspect the gourds, and insert their hands to extract the sugar. During the operation the blacks suddenly appear, and the monkeys, in their alarm, open their hands inside the gourds, and, thus hampered, fall an easy prey to their captors.

THE WHITE-FRONTED SAPAJOU

The white-fronted sapajou (*C. albifrons*), a common monkey in many parts of South America, is allied to the last species, but distinguished by its pale reddish brown colour, which becomes redder on the back and the outer surfaces of the limbs. The most characteristic colouring is the white which occupies the face, forehead, throat, shoulders, and chest.

THE WOOLLY MONKEYS

Mr. Bates, who described this species as being of a light brown colour, states that it is pretty generally distributed over the forest lands of the level parts of Brazil; and he saw it in large flocks on the banks of the Upper Amazon. The members of such a flock are described as affording a wonderful sight when leaping from tree to tree; for these monkeys, like their fellows of the same genus, are the best performers in this gymnastic exercise. "The troops," observes Bates, "consist of thirty or more individuals, which travel in single file. When the foremost of the flock reaches the outermost branch of an unusually tall tree, he springs forth into the air without a moment's hesitation, and alights on the dome of yielding foliage belonging to the neighbouring tree, maybe fifty feet beneath; all the rest following his example. They grasp, on falling, with hands and tail, right themselves in a moment, and then away they go along branch and bough to the next tree." Bates had one of these monkeys as a pet, which kept the house in a perpetual uproar, screaming in a piteous manner when alarmed, excited, or hungry. It was always making a noise of some kind; often screwing up its mouth and uttering a succession of loud whistling notes. Frequently this young sapajou, when following its master, would walk upon its hind legs alone, although it had never been taught to do so. One day, however, in endeavouring to wrest some fruit from an owl-faced night monkey, it attacked the latter so fiercely that it cracked its skull with its teeth, upon which its owner considered that he had had enough of pet sapajous.

THE WHITE-THROATED SAPAJOU

This monkey (*C. hypoleucus*) is an inhabitant of Central America. It belongs to the same group as the preceding species, from which it is distinguished by its colouring. The general colour of the fur is black, but the forehead and part of the crown of the head, as well as its sides, together with the throat and neck, are white, while the naked portion of the face is pale flesh-colour.

THE SMOOTH-HEADED SAPAJOU

The smooth-headed, monk, or yellow-headed sapajou (*C. monachus*), is a species from Rio Janeiro and other places in South-Eastern Brazil, deriving all its three names from the extremely close and short yellow hair with which the front of the head is covered (page 251).

The fur of this species is very short and stiff.

In colour the crown of the head, the whiskers, and chin, together with the shoulders, haunches, limbs, and tail, are pure black; the sides and back, more especially in the hind half of the body, are yellow, more or less mixed with black; while the sides of the neck, the chest, and the front of the shoulders are yellow, the forehead and temples being whitish yellow. Such are the striking colours of the typical form of this species, but there are several variations.

THE CRESTED SAPAJOU

The last member of this genus noticed here is the crested sapajou of Brazil (*C. robustus*), a species distinguished from those previously mentioned by



WHITE-THROATED SAPAJOUS

the long hair on the crown of the head forming a single central crest of a more or less conical shape. The general colour of the fur is bright red, with a black spot on the top of the crown, while the limbs and tail are blackish.

THE WOOLLY MONKEYS

The members of this group (genus *Lagothrix*) are best known by Humboldt's woolly monkey, first discovered on the Orinoco by the traveller whose name it bears, but also common in the upper part of the valley of the Amazon (page 254). This species is the only one that need be mentioned, although three or four others have been recognised.

The woolly monkeys take their name from the thick coat of woolly fur which is found beneath the longer hairs. This is one of the points by which they are distinguished from the sapajous. A more important point of difference is to be found in the

naked skin on the under part of the end of the tail—a character in which these monkeys resemble those of the next two genera. The woolly monkeys, however, have the same robust build as the sapajous, and thereby differ from the other members of this group of genera. They have well-developed thumbs, and the great length of the tail, along with its naked tip, renders it a prehensile organ of the most perfect type.

To the Portuguese colonists of Brazil these animals are known as macaco barrigudo, frequently abbreviated into barrigudo, the full name signifying "big-bellied monkey," and being applied to them in allusion to their bulky build, as contrasted with the slender form of their cousins, the spider monkeys. The ordinary form of Humboldt's woolly monkey has a general blackish grey colour, with the head, chest, under parts, and tail black. The hairs are dark grey with very short black tips on those parts of the body which are not black. Younger animals are more grey. Another phase, which has been regarded as a distinct species by some naturalists, differs from the typical form in having grey fur on the head. Bates states that both these monkeys live together in the same places, and are probably only differently coloured individuals of one and the same species. In one of the largest examples obtained by that traveller, the length of the head and body was 27 in., and that of the tail 26 in.; these dimensions only being exceeded among American monkeys by the black howler, whose head and body may measure 30 in. in length.

THE WOOLLY SPIDER MONKEYS

The woolly spider monkeys, of the genus *Brachyteles* or *Eriodes*, form a kind of connecting link between the woolly monkeys, on the one hand, and the true spider monkeys, on the other; having the woolly under-fur of the former but the slender build of the latter, while their thumbs are rudimentary. They differ, however, from both in that their nails are extremely compressed from side to side, and sharply pointed at the ends; while the partition between the nostrils is narrower.

Not much appears to be known of these monkeys, which are confined to South-Eastern Brazil, and have been divided into three species, mainly according to the degree of development of the thumb. Naturalists are, however, of opinion that these are merely varieties of a single species (*Brachyteles arachnoides*), since some individuals have a rudiment of a thumb on one hand and not a trace of one on the other. In the typical variety the general colour is ashy brown, often tending to ferruginous at the base of the root of the tail, with the naked parts of the face flesh-coloured; the females being of a paler hue. The thumb is totally wanting (page 255). There is

another variety, or race, which has a distinct rudiment of a thumb, and is of a dark brown colour, with white on the sides of the face.

THE SPIDER MONKEYS

The spider monkeys (genus *Ateles*) may be regarded as those members of the group most specially adapted to a purely arboreal life, as is shown by their slight bodies, the long, prehensile tail, naked below at the end, and the long, spider-like limbs, from which they derive their popular title. In the rudimentary condition, or total absence of the thumb, the spider monkeys may be regarded as holding the same relationship to the sapajous as is presented by the guereza monkeys (*Colobus*) of Africa to the langurs (*Semnopithecus*) of India; and it is probable that in both instances the abortion of the thumb is due to the uselessness of this digit in a hand fitted to act merely as a kind of hook in swinging from branch to branch.

In general characters the true spider monkeys agree with the woolly spider monkeys, but are readily distinguished by the total absence of the woolly under-fur, the comparatively slight degree of compression in the nails, and the greater width of the partition between the nostrils; the thumb being generally absent. They are, moreover, of far more active habits; and in this respect are only equalled by the langurs and gibbons of the Old World, over which they have the advantage of the prehensile tail. They not unfrequently use their tails to convey fruit and other articles of food to their mouths. Those who have seen spider monkeys swinging from rope to rope and leaping from side to side of their cages in menageries can, when the cage is sufficiently large, gain some idea of their marvellous activity, although in such confined spaces their movements bear no comparison to what the creatures are capable of when they enjoy the boundless freedom of their native forests.

It is noteworthy that the stomachs of the spider monkeys have a trace of the sacculated condition which distinguishes those of the long-limbed and long-tailed langurs and guerezas of the Old World. Their fur is generally smooth and stiff; and, as a rule, the hair on the crown of the head is directed forwards.

The number of species is very large, and mention need be made only of some of the better-known types. The genus has a wide geographical range, extending from Uruguay to Southern Mexico.

THE RED-FACED SPIDER MONKEY

The red-faced spider monkey (*Ateles paniscus*), named by the natives of Brazil coaita, is one of the best-known representatives of the genus. It is found over a large area of Brazil and Guiana; and,



HUMBOLDT'S WOOLLY MONKEY
Photograph by W. P. Dando

THE SPIDER MONKEYS

although exceeded in bulk by the woolly monkeys, is in point of length of body the tallest of all the monkeys of these regions. It has been long familiar to zoology, for its scientific name was given by Linnaeus, while its native designation, *coaïta*, was in use in Europe in Buffon's time. The coarse fur is black in colour, and short on the crown of the head, although long and projecting on the forehead. The distinctive feature of the species is the tawny flesh-coloured hue of the prominent naked portions of the face, from which it derives its name (page 256).

In Brazil this species is found all over the lowlands of the valley of the Amazon, but it does not range southwards beyond the limits of the river plains, where it is replaced by the white-whiskered spider monkey. Like the other species, it lives in small parties, and is comparatively silent. Its flesh is much esteemed by the natives of Brazil, who capture it alive by shooting it with arrows tipped with weak *urari* poison, and restoring it, when fallen, with salt.

"Coaitas," writes Bates, "are more frequently kept in a tame state than any other kind of monkey. The Indians are very fond of them as pets, and the women often suckle them, when young, at their breasts. They become attached to their masters, and will sometimes follow them on the ground to considerable distances. I once saw a most ridiculously tame *coaïta*. It was an old female, who accompanied its owner, a trader on the river, in all his voyages. By way of giving me a specimen of its intelligence and feeling, its master set to and rated it smartly, calling it scamp, heathen, thief, and so forth, all through the copious Portuguese vocabulary of vituperation. The poor monkey, quietly seated on the ground, seemed to be in sore trouble at this display of anger. It began by looking

earnestly at him, then it whined, and lastly rocked its body to and fro with emotion, crying piteously, and passing its long, gaunt arms continually over its forehead; for this was its habit when excited, and the front of the head was worn quite bald in consequence. At length its master altered his tone, 'It's all a lie, my old woman; you're an angel, a flower, a good, affectionate old creature,' and so forth. Immediately the poor monkey ceased its wailing, and soon afterwards came over to where the old man sat." The disposition of these monkeys is mild in the extreme, as they have none of the painful, restless vivacity of their cousins, the sapa-jous, and none of the surly and untamable temper of their more distant relatives, the howlers.

In the typical form of the red-faced spider monkey the thumb is absent. There is, however, a monkey similar to it in all respects, with the exception that it has a rudiment of the thumb on one or both hands. This monkey, which is known as the *chameck*, has been regarded as a distinct species, under the name of *A. subpentadactylus*, but it seems preferable to consider it merely as a variety of the red-faced spider monkey.

OTHER SPIDER MONKEYS

In Eastern Peru the place of the red-faced spider monkey is taken by a closely allied species (*A. ater*), in which the face is of the same black tinge as the fur. From this feature the species derives its distinctive title of the black-faced spider monkey; but it is further distinguished from the red-faced species by the shorter hair on the forehead.

Passing by one or two kinds, such as the grizzled spider monkey (*A. griseus*), we come to a very well-marked species, known as the hooded or black-capped spider monkey (*A. cucullatus*, page 257), first described from an example in the Zoological Society's Gardens in London, of which the exact

habitat was unknown, although believed to be Colombia. This species is distinguished by the length of the flaccid hair, which is a mixture of black and silvery grey in colour, and on the crown of the



THE WOOLLY SPIDER MONKEY

head is elongated, so as to form a large hood or pent-house over the eyebrows. The fur of the hands, feet, crown of the head, and nape of the neck is deep black, while the naked parts of the face are flesh-coloured.

The *chupa*, or white-whiskered spider monkey (*A. marginatus*), has already been incidentally mentioned as found in the Lower Amazon valley, to the south of the river plains which are inhabited by the red-faced species. It is of nearly the same size as the latter, but has moderately long hair, of a uniform black colour, with the exception of that on the forehead and the whiskers, which is white; the face being flesh-coloured. As in the last species, all trace of the thumbs has disappeared. It does not appear to be common, since Bates seems only to have come across one pair, both of which were shot, while specially searching for it in the valley of the Tapajos. Being at the time unable to obtain other animal food, this traveller was fain to try the flesh, and describes it as being the best-flavoured meat he had ever tasted, although it was with difficulty that he persuaded himself to make the attempt.

In Central America, northwards of the Isthmus of Darien, this group of monkeys is represented by *A. geoffroyi*, noticeable as being found at very high elevations. This species, also known as *A. melanochirus*, is the black-handed spider monkey, readily recognised by the hands, feet, and the crown of the head being of a full black, while the fur of the body is generally some shade of pale or reddish brown, although more rarely yellowish, or even yellowish white, and, indeed, extremely variable in coloration. There appears to be a complete gradation from the typical form, with flesh-coloured rings round the eyes, to one in which the face is wholly black, while the whiskers are pale reddish yellow, the patch of erect black hair on the forehead is yellowish at the base, and most of the other parts are brownish red.

With the long-haired white-bellied spider monkey (*A. vellerosus*) of Central America and Mexico we come to a species closely allied to the last, but distinguished by the under surface of the body and the inner sides of the lower legs and forearms being white or greyish white. The Mexican species is very variable in colour, shading from black to reddish, with the loins paler, and the under parts and inside of the forearms, together with the front of the thighs,

the inner surface of the legs, and the under side of the tail, whitish; the hair being rather long and somewhat limp. It is commonly found on the volcanic mountain known as Orizaba, near Vera Cruz, in the south of Mexico, where it ranges up to an elevation of some two thousand feet, living in troops in the forests of the deep valleys. In the neighbouring district of Oajaca, however, it reaches to a height of four thousand feet.

This is the only member of the group certainly known to range as far north as Mexico, the most northern locality for monkeys being apparently San Luis, Potosi, about 25° N. on the Tampico. These monkeys have been long known, and were described by Cuvier under the name of *coaita à ventre blanc*. Besides inhabiting Brazil, they were met with by Humboldt on the Orinoco. They are stated to assemble in considerable troops.



RED-FACED SPIDER MONKEYS

THE VARIEGATED SPIDER MONKEY

The variegated spider monkey (*A. variegatus*) is remarkable for its brilliant colouring and its wide geographical distribution; the latter extending from the upper reaches of the Amazon in Peru to the banks of the Rio Negro, flowing from Venezuela into the lower portion of the Amazon, and northwards into the Andes of Ecuador and Colombia. It was originally described by the German naturalist Wagner, from specimens obtained on the Rio Negro. Later a monkey from the river Tigre, which flows

from the north into the Amazon soon after it takes its great easterly bend on leaving Peru, was described as a new species, under the name of Bartlett's spider monkey (*A. bartletti*), but it proved to be identical with the variegated spider monkey of the Rio Negro.

The variegated spider monkey is characterised by its thick, long, and soft hair, of which, although the general colour is black, the cheeks are white. There is a band of bright reddish yellow passing across the forehead a little distance above the eyes; while the under surface of the tail, the under parts of the body, and the inner surfaces of the limbs are yellow in the male and greyish white in the female. With the above variations in colour it will readily be imagined that the male of this species is a striking animal. In addition to more sombre tints, the female has the lines of separation between the colours less marked (page 257).

THE DOUROUCOLIS

On the Tigre these monkeys live in small parties and travel rapidly through the forests in search of their favourite food, which is a berry resembling a gooseberry in size, but with a hard stone inside. Mr. A. D. Bartlett states that he had to ascend to the very summits of the ranges bordering the Tigre valley before his search was rewarded. "Here," he wrote, "we came across a number of them—about eight or nine. I shot the male that is now in the British Museum, and my Indians brought down another with a poison dart. Having obtained two of them, I was satisfied that I had found a new species. While, however, I was busy preparing the first specimen, my Indians had quietly placed the other on the fire, and, to my great horror and disgust, they had singed the hair off, and thus spoilt the specimen. Of course, I was obliged to keep the peace, for they had not tasted meat for some days, and the monkey proved a very dainty dish."

The first example of this monkey brought alive to England came from the Upper Caura River, in Venezuela, and arrived at the Gardens of the London Zoological Society on July 14, 1870; but its stay was of the briefest, as it died on August 18 following.

THE DOUROUCOLIS

The douroucolis, or nocturnal owl-faced monkeys (genus *Nyctipithecus*), belong to a group of three genera distinguished from the American monkeys hitherto noticed by their long tails not being prehensile. All have well-developed thumbs, and their form is massive. They agree with the members of the preceding group in the upright profile of the face, and also in the fact that the front or incisor teeth of the lower jaw are placed vertically.

The douroucolis are distinguished from the other genera of the group by their rounded heads and enormous eyes. The latter are, indeed, so large that in the dried skull the sockets occupy almost its entire width, being separated from one another by a mere line of bone, considerably narrower than the opening of the nostrils. Another distinctive feature is the narrowness of the partition between the two nostrils, which is more like that of the monkeys of the Old World than that of the other New World monkeys. The ears are short, and the hair round the eyes is

arranged in a radiating manner, after the fashion of the discs of feathers round the eyes of an owl. All the species are of relatively small size, and of purely nocturnal habits.

Apparently from their small ears the traveller Humboldt gave them the title of earless monkeys (*Aotus*), but the name nocturnal monkey (*Nyctipithecus*) had been applied at an earlier date. I am unacquainted with the origin of the name douroucoli. To the inhabitants of Ega, on the Upper Amazon, these monkeys are known by the name of ei-a.

At Ega, wrote Bates, "I found two species closely related to each other, but nevertheless quite distinct, as both inhabit the same forests, namely, those of the higher and drier lands, without mingling with each other or intercrossing. They sleep all day in hollow trees, and come forth to prey on insects and eat fruits only in the night. They are of small size, the body being about a foot long and the tail 14 in., and are thickly clothed with soft grey and brown fur, similar to that of a rabbit. Their physiognomy reminds one of the owl or tiger-cat. The face is round and encircled by a ruff of whitish hair; the muzzle is not at all prominent; the mouth and chin are small; the ears are very short, scarcely appearing above the hair of the head; and the eyes are large and yellowish in colour, imparting the staring expression of nocturnal animals of prey. The

forehead is whitish and decorated with three white stripes."

THE THREE-BANDED DOUROUCOLI

This species (*Nyctipithecus trivirgatus*) was first discovered by Humboldt on the banks of the Cassiquiare, near the headwaters of the Rio Negro, in Venezuela, but it also occurs in Guiana and Brazil. Its chief distinctive character lies in the fact that the three bands on the forehead continue distinct from one another on to the crown of the

head. The fur is relatively short and the tail cylindrical. The general colour is greyish brown, with a darker stripe down the middle of the back; the chest and under parts being rusty colour, and the tail blackish brown, except on the under part of its root, where it becomes yellowish (page 258).

The account given of this monkey by Alexander von Humboldt accords very closely with the



THE VARIEGATED SPIDER MONKEY
Photograph by W. S. Beiridge



THE HOODED SPIDER MONKEY

descriptions of later naturalists. Humboldt refers to the difficulty of taming it, and states that one kept in his possession for nearly five months could not be reconciled to captivity. It slept during the day, concealing itself in the darkest corner it could find, and when awake could but seldom be induced to play with its master. Its agility in capturing flies was very remarkable. If irritated it hissed and struck out with its paws after the manner of a cat, at the same time inflating its throat. Its voice, for so small an animal, was very powerful, and Humboldt compares its cry on some occasions to the roar of the jaguar, while at others it is described as a kind of mewling, accompanied by a deep guttural sound.

Bates, who kept a specimen for many months when on the Amazon, observes that "these monkeys, although sleeping by day, are aroused by the least noise; so that when a person passes by a tree in which a number of them are concealed, he is startled by the apparition of a number of little striped faces crowding a hole in the trunk. It was in this way that my companion discovered the colony from which the one given to me was taken. I was obliged to keep my pet chained up; it never became thoroughly familiar." After referring to an individual of the next species, the same naturalist states that his douroucoli "was kept in a box, in which was placed a broad-mouthed glass jar; into this it would dive head foremost when anyone entered the room, turning round inside, and thrusting forth its inquisitive face an instant afterwards to stare at the intruder. It was very active at night, venting at frequent intervals a hoarse cry, like the suppressed barking of a dog, and scampering about the room, to the length of its tether, after spiders and cockroaches. In climbing between the box and the wall, it straddled the space, resting its hands on the palms and tips of the outstretched fingers, with the knuckles bent at an acute angle, and thus mounted to the top with the greatest facility. Although seeming to prefer insects, it ate all kinds of fruit, but would not touch raw or cooked meat, and was very seldom thirsty. I was told by persons who had kept these monkeys loose about the house that they cleared the chambers of bats as well as insect vermin. When approached gently, my ei-a allowed itself to be caressed; but when handled roughly, it always took alarm, biting severely, striking out its little hands, and making a hissing noise like a cat."

The feline douroucoli (*N. felinus*) is closely allied

to the last species, from which it is distinguished by the fact that the three dark bands on the forehead meet on the top of the forehead instead of continuing separately to the crown (page 259). It is an inhabitant of Brazil, dwelling in the same forests as the three-banded douroucoli, but always remaining separate, and being apparently much more rare. Bates described a perfectly tame specimen as being as lively and nimble as any sapajou, but far less mischievous and more confiding in its disposition, delighting in being caressed by visitors to the house of

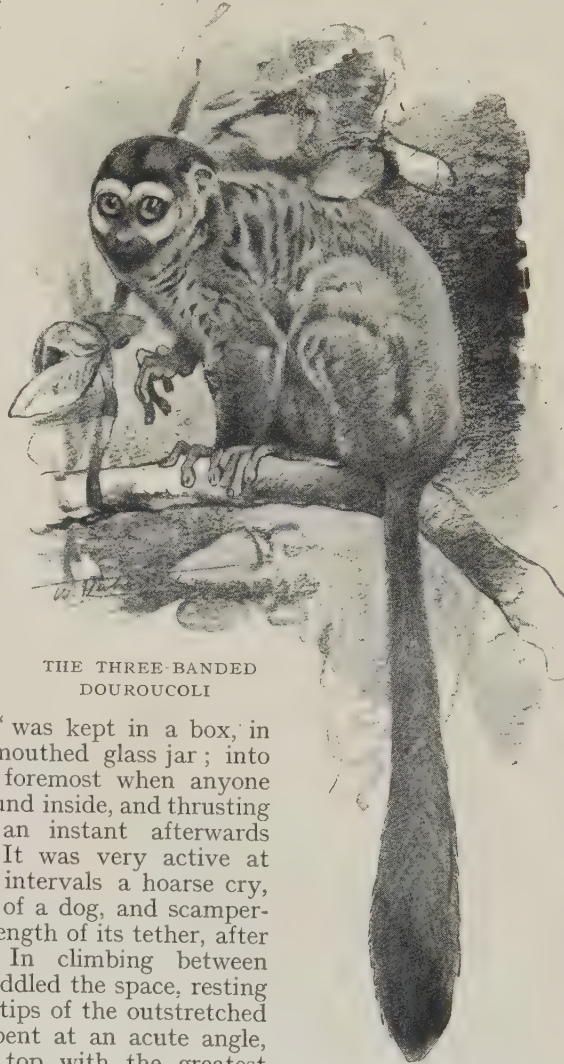
its owner, the judge of Ega, with whom it was a favourite for its pretty appearance and gentle ways.

The broad-tailed or lemurine douroucoli (*N. lemurinus*) derives its name from its broad and bushy tail, in which the hairs spread out on each side like those in the tail of a squirrel. It is further characterised by the greater length of the hair on the head and body, and also by the presence of a round pale-coloured spot over each eye, separated by a broad dark median line; the three frontal bands of the first two species being wanting. This douroucoli is an inhabitant of Colombia, but we have not met with an account of its habits, which are, however, doubtless, much the same as those of the other species.

THE SQUIRREL MONKEYS

The elegant saimiris, or squirrel monkeys, of the genus *Chrysothrix*, form a small group of species closely allied to the titis—under which name those of this group are often included—but distinguished by several important features. In the first place, the eyes are very large,

approaching in this respect those of the douroucolis, from which these monkeys are distinguished by the wide partition between the nostril and the peculiar form of the head. The peculiarity in the shape of the head consists in its great elongation from front to back; the aperture by which the spinal cord passes out from the brain to the backbone being situated far in advance of the hinder occipital region of the skull, which projects backwards behind the neck in a manner unknown in any other monkeys. Other characteristic points are to be found in the



THE THREE-BANDED
DOUROUCOLI

THE TITI MONKEYS

relatively large size of the tusks, or canine teeth, and also the comparatively short hair clothing the tail. The squirrel monkeys, or saimiris, as they were called by Buffon, also differ from the douroucolis in their diurnal habits.

The common squirrel monkey (*C. sciurea*), far the best-known representative of the genus, is an inhabitant of Brazil and the valley of the Orinoco. It is a small animal, not much larger than a squirrel, with the head grizzled grey, tending to blackish, and the fur of the body also grey, with a black mottling, but more or less tinged with gold in the region of the back. The outer sides of the forearms are yellowish, the paws whitish, and the long and slender tail is tipped at the end with black.

Writing of this species, Humboldt observes that no other monkey has so much the physiognomy of a child; it exhibits a similar expression of innocence, a similar playful smile, and a similar sudden change from joy to sorrow, or the reverse. When seized with fear, its eyes are suddenly suffused with tears. The one in possession of Humboldt was extremely fond of spiders and insects, and when shown uncoloured figures of wasps, etc., in a book of natural history, darted forwards as if to seize the insect. It remained, however, perfectly indifferent to figures of heads and skeletons of mammals.

Another species is the short-tailed squirrel monkey (*C. usta*), distinguished from the last mainly by its shorter tail and naked ears, and inhabiting the same regions. In some specimens the outer side of the forearm is of the same colour as the body, but in others it is shot with gold, as in the typical squirrel monkey.

In Bolivia the squirrel monkeys are represented by a well-marked species (*C. boliviensis*) differing from both the above by its black head, and by the hairs of the body being yellow with long black tips. These parti-coloured hairs cause the general hue of the fur to be golden brown. The upper part of the body, however, is of the same black hue as the head; and this colour likewise prevails on the tail, which is of moderate length. The face, throat, and the inner surfaces of the thighs are, on the contrary, yellowish grey.

THE TITI MONKEYS

The titis of the genus *Callithrix*, which form the last members of the present group of American monkeys, are distinguished from the squirrel monkeys by their round and well-formed heads, which

are not elongated posteriorly, by their smaller eyes, less developed canine teeth, and the much longer hair clothing the tail. They are chiefly inhabitants of Brazil and other parts of the Amazon valley, and are represented by several species, some of which have been exhibited alive in England. Only a few of the best-known species call for notice.

The red titi of Brazil (*C. cuprea*), belonging to a group in which the fur is soft but intermingled with a number of long, stiff hairs, takes its name from the reddish bay colour of its hands, which forms a ready means of distinguishing it from the next species. The colour of the upper parts is blackish mixed with grey, but the cheeks, throat, under parts, feet, and legs are of the same reddish bay hue as the hands; the tail being generally rather darker than the back, although instances are known in which it has a white tip.

The second Brazilian species, *C. torquata*, known to the natives as the whaipu-sai, is readily distinguished from the preceding by the white hair of the hands. In general colour it is reddish brown tending to black, the hairs being red at the root and black at the tips. The face is surrounded by a narrow band of pure white hairs, and there is a narrow reddish white collar round the neck, from which the species takes its name. The forehead, feet, and tail are quite black. The remarkable colouring of this species has obtained for it among the Creoles of Brazil the name of the widow monkey; the white rim round the face, the whitish collar, and the white hands being likened to the veil, handkerchief, and gloves worn by widows in its native country.

In Guiana this species is replaced by the closely allied white-chested titi (*C. amicta*), which is distinguished by the presence of a pure white spot on the chest, the general colour being black tinged with red.

Another Brazilian species is the moloch titi (*C. moloch*), which, while agreeing with those just noticed in the nature of the fur, differs in that the colour of the hands and feet is of nearly the same grey hue as that of the

back. The general colour of the upper parts is dark grey, with a grizzle of black and red; the cheeks, chest, and under parts being reddish, and both the hands and feet dark grey.

The reed titi (*C. donacophila*) is a paler species, closely allied to the moloch. Bates states that while on the Lower Amazon, when going ashore early one morning, he found the forest resounding with the



THE FELINE DOUROUCOLI
Photograph by Lewis Medland



THE COMMON SQUIRREL MONKEY
Photograph by W. S. Berridge

yelpings of a flock of whaipu-sai monkeys, which he thought probably belonged to this species. Although unsuccessful in obtaining a specimen, he was enabled to see them for a moment, and describes them as of small size, and clothed with long fur of a uniform grey colour.

The black-fronted titi (*C. nigrifrons*) differs from any of those yet noticed in its rigid and bristly fur, and also in both hands and feet being black. Its general colour is grey, tinged with black; but it takes its name from the black forehead; the ears, a spot on each side of the neck, as well as the hands and feet, and the inner surfaces of the forearms and legs being of the same sombre tint. The fur of the tail has a reddish tinge; while the back of the crown of the head and the nape of the neck are whitish grey.

The nearly related brown titi (*C. brunnea*), which is also known by the name of the masked titi, is subject to a great amount of individual variation in colour.

The last representative of these monkeys to be noticed is the black-handed titi (*C. melanochira*), one of two species which, while agreeing with the one last mentioned in its black hands and feet, is readily distinguished from the whole of those here noticed by the fur being soft and woolly, without any intermixture of long, stiff hairs. The general colour is reddish, but the crown of the head, the throat, and the inner surfaces of the limbs are a mixture of black and grey. There is a variety known in which the fur is bright red. This species has been obtained from Bahia, on the eastern side of Equatorial Brazil, but little or nothing seems to have been recorded with regard to its habits.

THE SAKI MONKEYS

The saki monkeys (genus *Pithecia*) typify a group of two genera, which, while resembling the douroucolis and their allies in the non-prehensile character of the tail, are distinguished from them, and likewise from all other American monkeys, by the fact that all the front or incisor teeth of the lower jaw, instead of being vertical, are inclined forwards. In this respect these monkeys resemble lemurs. Like the titis, they approximate to the howling monkeys by having the sides of the hind part of the lower jaw considerably expanded.

Most of the sakis are characterised by having long hair on the crown of the head, which may either be divided in the middle line, or may radiate from the centre; and they all have whiskers and a beard, the latter being either broad and single, or separated by a division in the middle, and inclining back on each side. While in some species, like Humboldt's saki, the long hair covers the head, body, and tail, in others this long hair is confined to the

head, where it may be present on the crown, cheeks, and chin, or only on the last two parts.

The headquarters of the sakis are Guiana and the valley of the Amazon, although they are also found in other districts. They are delicate animals, difficult to keep in captivity, and gentle and inoffensive in disposition when in confinement. Very little is known of their habits in the wild state, although it appears that they are normally silent.

THE WHITE-HEADED SAKI

The white-headed saki (*Pithecia leucocephala*) is an inhabitant of Guiana, and may be regarded as the typical representative of the group. It is characterised by its white or



THE WHITE-HEADED SAKI
Photograph by W. S. Berridge

yellowish forehead, marked by a central streak of black, the rest of the long fur being black, and the hairs of the same colour throughout. In common with the two following species, the hair on the crown of the head is arranged in a radiating manner, the beard is broad and single, and the tail clothed with long hair, which, like that on the body, is stiff and coarse.

HUMBOLDT'S SAKI

In the Amazon valley, as far west as Ecuador, the

white-headed saki is replaced by a species distinguished by having no black streak down the middle of the white or yellowish forehead, and also by the greater length of the hair covering the head and body. This species is Humboldt's saki (*P. monachus*), also known as the hairy saki (*P. hirsuta*), and—by the inhabitants of the Upper Amazon—as the parauacu (page 265). The general colour is black with a grey grizzle, and the tip of each hair white. There is, however, a paler variety (*P. albicans*), in which the general colour is greyish white, with only a large patch on the back and the tail black, each hair being tipped with pure white, as in the ordinary variety.

During his sojourn at Ega—or Tefé, as it is more frequently called nowadays—on the right bank of the Amazon, Bates saw several specimens of this monkey. He describes it as being “a timid, inoffensive creature, with a long, bear-like coat of speckled grey hair. The long fur hangs over the head, half concealing the pleasing, diminutive face, and clothes also the tail to the tip, which member is well developed, being 18 in. in length, or longer than the body. The parauacu is found on the *terra firma* lands of the north shore of the Solimões, from Tunantins to Peru. It exists also on the south side of the river, namely, on the banks of the Tefé, but there under a changed form, which differs a little from its type in colours.” The variety here alluded to is the whitish race of which mention was made a few sentences back.



RING-TAILED LEMURS AT PLAY

Noisy creatures, their whereabouts "are discoverable by the loud cries they are continually uttering."



AN INDIAN TIGER AND ITS PREY

"The food of tigers varies greatly: but the typical jungle tiger lives chiefly upon deer, wild pigs and antelopes



LEOPARD STALKING A VICTIM

From its stronghold the great spotted cat "descends with remarkable celerity and stealth, under cover of the rocks to cut off any straggling animal."



LYNX MAKING A RECONNAISSANCE

"In disposition the lynx is extremely savage, and will often kill more animals than it can devour"

Bates has several interesting notes about this saki. It is, he says, "a very delicate species, rarely living many weeks in captivity; but anyone who succeeds in keeping it alive for a month or two gains by it a most affectionate pet." He then notices another specimen of the pale variety which, belonged to a French inhabitant of Ega. This animal "became so tame in the course of a few weeks that it followed him about the streets like a dog. My friend was a tailor, and the little pet used to spend the greater part of the day seated on his shoulder, while he was at work on his board. It showed, nevertheless, a great dislike to strangers, and was not on good terms with any other member of my friend's household but himself. I saw no monkey that showed so strong a personal attachment as this gentle, timid, silent little creature. The eager and passionate cebi [sapajous] seem to take the lead of all the South American monkeys in intelligence and docility, and the coaita [spider-monkey] has perhaps the most gentle and impressible disposition; but the parauacu, although a dull, cheerless animal, excels all in this quality of capability of attachment to individuals of our own species." It is not wanting, however, in intelligence as well as moral goodness, proof of which was furnished one day by an act of our little pet. My neighbour had quitted his house one morning without taking the parauacu with him, and the little creature having missed its friend, and concluded, as it seemed, that he would be sure to come to me, both being in the habit of paying me a daily visit together, came straight to my dwelling, taking a short cut over gardens, trees, and thickets, instead of going the roundabout way of the street. It had never done this before, and we knew the route it had taken only from a neighbour having watched its movements. On arriving at my house, and not finding its master, it climbed to the top of my table, and sat with an air of quiet resignation waiting for him. Shortly afterwards my friend entered, and the gladdened pet then jumped to its usual perch on his shoulder."

This little creature did not long survive; and if the life of these sakis is thus short when in comparatively free captivity in their native land, it must be doubly so in a cold northern climate. This is confirmed by the record of two specimens exhibited in the Zoological Gardens in London, one of which was received on May 15, 1866, and died on the 26th of the following June.

It is curious that there appears to be a marked difference in the habits of some of the sakis in regard to drinking. The black saki, for instance, is reported to drink freely, always bending down on its hands and putting its mouth to the water, heedless of

wetting its head and regardless of the presence of spectators; whereas the next species has a totally different mode of drinking.

THE RED-BACKED SAKI

The red-backed saki (*P. chiropotes*), first obtained by Humboldt on the banks of the Orinoco, but also occurring in Guiana, is the first member of another group of the genus, distinguished in several respects from the species already described.

In the first place, the hair of the head, although radiating from a central point in the young, in the adult is divided by a median parting, and falls down on each side. The long beard is also divided by a gap in the middle of the chin into two lateral moieties, while the fur on the body, instead of being long and harsh, is short and soft. The tail has shorter hair than in the last group, and is thick and club-shaped. Finally, the hind part of the lower jawbone is more expanded than in the typical group. The peculiar form of the neatly divided and flattened hair of the head gives these animals the appearance of wearing a wig.

The general colour of the fur is blackish brown, but there is a considerable area on the back and shoulders of a yellowish red tint, from which the species derives its name. The tail is very thick and bushy, and the beard greatly developed.

Humboldt describes the red-backed saki as "a robust, active, fierce, and untamable animal; when irritated it raises itself on the hinder extremities, grinds its teeth, rubs the end of the beard violently, and darts upon the person who has excited its displeasure. In confinement it is habitually melancholy, and is never excited to gaiety, except at the moment of receiving its favourite food. It seldom drinks, but when it does so the operation is performed in a peculiar manner. Thus, instead of

putting its lips, after the manner of other monkeys to the water or the vessel containing it, this species conveys it to its mouth in the hollow of the hand, at the same time bending forward its head. It is not, however, easy to witness this singular trait of character, since the animal is unwilling to satisfy its thirst when watched or likely to be observed." In their wild state the same traveller relates that these animals live only in pairs. Their voice, which

is but seldom heard, is described as a kind of disagreeable grunt.

Closely allied to the above is the black saki (*P. satanas*), which is an inhabitant of Brazil. It is distinguished by the absence of the yellowish red on the back and shoulders; the whole of the fur being of a uniform blackish brown colour, generally tending to a more decided black in the males, and



HUMBOLDT'S SAKI
Photograph by W. S. Berridge

browner in the females. In a male example in the Paris Museum the back is brown and the wig black, while in a female both the back and the wig are more fulvous. Unusually black individuals have been described as a distinct species, under the name of *Chiropotes ater*.

The black saki, or cuxio, as this species is termed in Brazil, appears to be restricted to the lower parts of the Amazon valley. It has been observed at Cameta, on the southern side of the Amazon delta, and is stated to dwell in the most retired parts of the forests, in regions where the ground is not subject to inundations.

The last representative of these monkeys is the white-nosed saki (*P. albinasa*), which is likewise an inhabitant of the dense forests of the valley of the Amazon, and is deep black in colour, with a paler tinge on the tips of the hair, except on the nose, which is pure white, thereby rendering the species easily recognisable.

THE UAKARI MONKEYS

Just as among the monkeys of the Old World a great variation is found in regard to the relative length of the tail in closely allied forms, so in the New World there is a group of monkeys closely allied to the sakis, but distinguished by the extreme shortness of this appendage, and thereby differing from all other American monkeys. From their peculiar colouring two of the uakaris, as these monkeys are called, are among the most remarkable mammals in the world.

All the three species of uakari have long and silky hair, directed forwards on the forehead, but there is scarcely any distinct beard. The tail is very short, never being more than about one-third of the length of the body, and sometimes being reduced to a stump. From this feature they were first called *Brachyurus*, but since this term had been already applied to another group of animals it had to be changed, and the uncouth name *Uacaria* was adopted. The shelving forward of the lower incisor teeth, noticed as characteristic of the sakis, is still more marked in the uakaris.

THE BALD UAKARI

The bald uakari (*Uacaria calva*) is one of two closely allied monkeys found in the valley of the Upper Amazon, distinguished by their brilliant scarlet faces and the light colour of the long hair of their bodies. The length of the head and body of

this species is about 18 inches, the whole of the body, from the neck to the tail, being clothed with long, straight, shining, whitish hair. The head is nearly bald, having only a very thin crop of short grey hairs (page 35). Beneath the chin and on the sides of the face are bushy, sandy whiskers; while the tint of the eyes is reddish yellow. The contrast between these colours and the vivid scarlet of the naked part of the face must be very striking when the animal is alive, but, owing to the fugitive nature of the face-pigment, is lost in museum specimens.

This monkey has an extremely limited distribution, being found only on the left bank of the Amazon, in the latitude of about 3° S., its small area being limited to the east by the Japura and to the west by the Putumayo, or Ica, as it is often called. Bates states that in this area the uakari "lives in small troops among the crowns of the lofty trees, subsisting on fruits of various kinds." Hunters say it is pretty nimble in its movements, but is not much given to leaping, preferring to run up and down the larger boughs in travelling from tree to tree. The mother, as in the other species of the monkey order, carries her young on her back. Individuals are obtained alive by shooting them with the blow-pipe and arrows tipped with diluted urari poison.

They run a considerable distance after being pierced, and it requires an experienced hunter to track them. He is considered the most expert who can keep pace with a wounded one, and catch it in his arms when it falls exhausted. A pinch of salt, the antidote to the poison, is then put into its mouth, and the creature revives. The species is rare, even in the limited district which it inhabits.

Uakaris are never known to descend of their own accord to the ground, the forests inhabited by them being inundated during the greater part of the year. Hence the shortness of their tails is no indication of their habits being more terrestrial than those of the long-tailed sakis.

THE RED-FACED UAKARI

On the western side of the Putumayo the bald uakari is replaced by an allied species, the red-faced uakari (*U. rubicunda*), which appears to have an equally confined area, although the exact western limits of its range are unknown (see page 267). This uakari differs from the preceding in the hair of the body and the limbs being of an almost uniform rich deep chestnut hue, only becoming rather paler on the neck. This is in marked contrast to the pale sandy white, tending slightly to rufous,



THE BLACK SAKI

From the "Proceedings" of the Zoological Society

THE HOWLING MONKEYS

on the under parts and the inner surfaces of the limbs, characteristic of the bald uakari. Both species agree, however, in their brilliant scarlet faces, and in having hair of a rich chestnut tint beneath the throat; and there can be no doubt but that they are extremely closely related, and have acquired their slight differences of coloration by being now completely separated from one another, although descended, as may reasonably be conjectured, at no very distinct epoch from a common ancestor.

THE BLACK-HEADED UAKARI

The most northerly representative of these monkeys is the black-headed uakari (*U. melanocephala*), which is found in the forests to the north of the Rio Negro, especially on the Cassiquiare and the Rio Branco. It thus becomes a zoological feature of the basins of both the Amazon and the Orinoco, so that it has a larger distributional area than either of the other species, from both of which it is widely different in coloration. The general colour is blackish, but the back and sides of the body are yellowish, while the loins, the outer surface of the thighs, and the tip of the tail are reddish chestnut, the face, hands, and feet being completely black.

THE HOWLING MONKEYS

The howling monkeys, or howlers (genus *Alouatta*, or *Mycetes*), derive their name from their vociferous cries, which are sufficient to distinguish them from all other American monkeys. To produce this extraordinary noise, there is a peculiar hollow shell of bone joining on to the upper part of the windpipe, corresponding to the so-called hyoid bone of man, which is a very small and solid structure. The resonance of the voice within this cavity communicates to the cry its peculiar intensity. In order to provide space for this bony shell the sides of the lower jawbone are extremely deep, and by this character, as well as by the extreme flatness of the part containing the brain, the peculiar skull may always be recognised. Bates surmises that their "harrowing roar," as he calls it, may serve to intimidate enemies.

The howlers differ from the two preceding groups, and agree with the spider-monkeys and their allies, in having prehensile tails, in which the under surface of the extremity is naked. In addition to the presence of the large bony swelling at the top of the windpipe, they may be at once distinguished from all other prehensile-tailed monkeys by the extreme obliquity of the plane of the face and the projecting muzzle.

This obliquity is connected with the flattening of the hind part of the skull, already referred to, and is so marked that the profile inclines backwards almost in a straight line from the muzzle to the crown. Like all American monkeys, except the spider-monkeys and some of their allies, the howlers have well-developed thumbs. Their face is naked, with the muzzle very projecting, the naked parts being surrounded by a fringe of long hair on the forehead, cheeks, and chin. On the forehead this long hair may be directed either backwards or forwards, but that of the whiskers and beard always hangs down. The hair of the body, although shorter than that surrounding the face, is relatively long.



RED-FACED UAKARI
Photograph by Lewis Medland

The howlers are especially abundant in Brazil, but they also range into Central America. They are represented by a considerable number of species, but since these are chiefly distinguished from one another by the colour of their hair, and there is considerable individual and sexual variation in this respect, it is in some cases difficult to decide which variations ought to be regarded as indicating distinct species, and which merely local races. The food of these monkeys is stated to consist entirely of leaves. Humboldt says that, when travelling in the neighbourhood of the Orinoco, the rising of the sun was always heralded by the cries of the howlers. Frequently this traveller and his companion, Bonpland, observed troops of these monkeys moving slowly in procession from tree to tree. A male was always followed by a number of females, several of the latter bearing their young on their shoulders. The uniformity with which they perform their movements is very remarkable. Whenever the branches of neighbouring trees do not touch one another, the male, who leads the party, suspends himself by the naked prehensile part of his tail, and, letting fall the rest of his body, swings himself till in one of his oscillations he reaches the neighbouring branch. The whole file performs the same movements at the same spot. The Indians informed Humboldt that when these monkeys filled the forests with their howling there was always one that chanted, as leader of the chorus. During a long interval one solitary and strong voice was generally distinguished, till its place was taken by another of a different pitch.

THE BLACK HOWLER

We select as our first example of that group of howlers in which the hair of the forehead is directed forwards so as to overhang the eyes, and the crown of the head is smooth, with radiating hairs, the black howler (*A. nigra*).

It is a native of Brazil. The adult males have their fur mainly uniform black, interspersed with red hairs on the flanks and loins. The females and young males are of a dingy white, and were described as belonging to a distinct species under the name of *A. straminea*. At one time there were young males of the black howler in the Jardin des Plantes, at Paris, which actually changed from the white into the black state.

The yellow-handed howler (*A. belzebul*) is another Brazilian representative of this group, which has been known since the time of Linnaeus. It appears to vary considerably in colour, so that one variety was described as a distinct species (*A. flavimanus*). The general colour of the fur may be either uniform black or reddish, with some brown hairs on the shoulders; but the hands and feet, as well as a line running down the middle of the upper surface of the tail, the tip of the same, together with a spot in front of each ear, and another on the knee, are invariably reddish yellow. The variety which is reddish-coloured all over is the prevalent type of howler in Para, on the southern side of the delta of the Amazon; while in the island of Marajo, or Macajo, in the middle of the delta, this form is replaced by the darker one with yellowish hands and feet.

The red-and-yellow howler is a variety of *A. nigra* from Brazil in which the general colour is dark chestnut, with the back and sides golden yellow, and the beard somewhat darker.

Speaking generally, Bates says that howlers are the only monkeys the natives of the Lower Amazon forests have not succeeded in taming. Even in captivity they do not survive long, as a rule.

VERA CRUZ HOWLER

As the black howler is the most southerly representative of the genus, so the Vera Cruz howler (*A. villosa*) is its most northerly example. This species differs from the black howler in its long, soft hairs, which near their bases show a rusty tinge, in the hair of the face being inclined forwards instead of reversed, and also in the colour of the female and young being black, like that of the male.

THE RED HOWLER

The red or golden howler (*A. seniculus*) is perhaps the best-known representative of the group in which the hair is bent back so as to form a ridge across the centre of the crown of the head. The colour is reddish chestnut, but golden yellow in the middle of the back. In young individuals the hairs are short and stiff, without under-fur, and uniformly coloured throughout their length. In older individuals, however, they become long, soft, and silky, and are brown at the roots, and golden or chestnut-coloured at their tips; while at the same time a thick under-fur is developed. Old individuals with this long, silky kind of hair have been described as a distinct species, under the name of the silky howler (see page 165).

This howler appears to be mainly a northern form, occurring in Colombia on the west, and in Guiana on the east side of South America; while, according to Bates, who describes its fur as being of a shining yellowish red colour, it is the sole representative of the howlers in the Upper Amazon valley. It also occurs in Ecuador, and is represented by a pale variety in Bolivia.

The red howler is one of the two species of this genus that have been exhibited in the gardens of the Zoological Society in London. It is, however, difficult to keep alive for any length of time, and of two specimens received from the Dekka River, near Cartagena, on August 28, 1863, the one died on September 25, and the other on October 7 of the same year. Writing of these howlers, which he states are known to the natives as ouarines, and on the Demerara, in Guiana, are commonly called red monkeys, Charles Waterton states "that nothing can sound more dreadful than the nocturnal howlings of



BLACK HOWLERS

EXTINCT AMERICAN MONKEYS

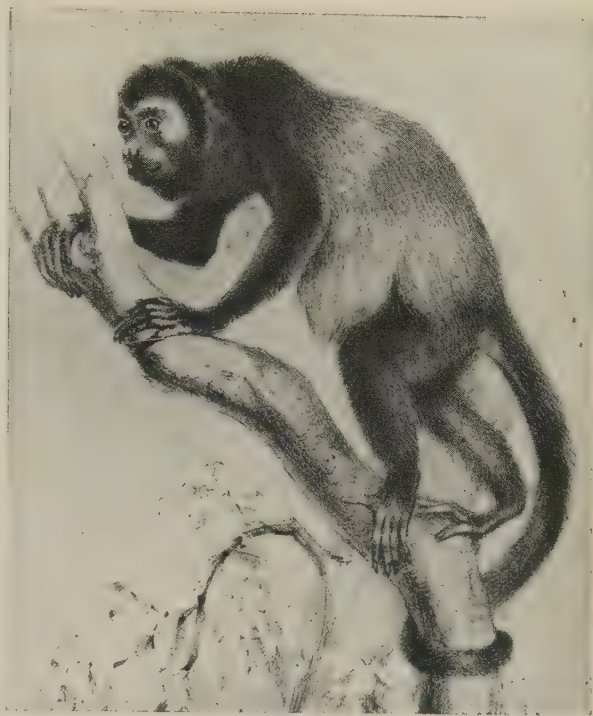
this red monkey. Whilst lying in your hammock amid these gloomy and immeasurable wilds, you hear him howling at intervals from eleven o'clock at night till daybreak. You would suppose that half the wild beasts of the forest were collecting for the work of carnage. Now it is the tremendous roar of the jaguar, as he springs upon his prey; now it changes to his terrible and deep-toned growlings, as he is pressed on all sides by superior force; and now you hear his last dying groan beneath a mortal wound. Some naturalists have supposed that these awful sounds, which you would fancy are those of enraged and dying wild beasts, proceed from a number of red monkeys howling in concert. One of them alone is capable of producing all these sounds; and the anatomists, on an inspection of his trachea [windpipe], will be fully satisfied that this is the case. When you look at him, as he is sitting on the branch of a tree, you will see a lump in his throat the size of a hen's egg. In dark and cloudy weather, and just before a shower of rain, this monkey will often howl in the day-time; and if you advance cautiously, and get under the high and tufted trees where he is sitting, you may have a capital opportunity of witnessing his wonderful powers of producing these dreadful and discordant sounds. Thus one single solitary monkey, in lieu of having others to sit down and listen to him, according to the report of travellers, has not even one attendant. Once I was fortunate enough to smuggle myself under the very tree on the higher branches of which was perched a full-grown red monkey. I saw his huge mouth open; I saw the protuberance on his inflated throat; and I listened with extreme astonishment to sounds which might have had their origin in the infernal regions."

THE BROWN HOWLER

The brown howler (*A. ursina*) is a Brazilian species, apparently found only or chiefly south of the Amazon. Its usual colour is a blackish brown, more or less washed with yellow; but some varieties are almost entirely yellow, this being most marked on the limbs and tail. The howler described as *A. fusca*, of which specimens have been exhibited in the Zoological Society's Gardens in Regent's Park, is merely a variety of this species. It has been observed that the specimens of this monkey from the more northerly regions of Brazil are rufous or ferruginous in colour, while the females and those from the more southern regions of the country are brown or blackish brown. This species is very closely allied to the red howler.

THE MANTLED HOWLER

In Costa Rica, and probably also in other districts of Central America, the howling monkeys are represented by a well-marked species, known as the mantled howler (*A. palliata*). This monkey is characterised by the presence of a fringe of long brownish yellow hair running along the lower part of the flanks, so as to form a kind of mantle on each side of the body. The general colour of the



MANTLED HOWLER

From the "Proceedings" of the Zoological Society

fur is blackish brown, the hairs on the middle of the back, as well as on the upper parts of the sides, being yellowish brown, with black tips.

EXTINCT AMERICAN MONKEYS

The extinct monkeys which have left their remains in the great caverns of Brazil, or in the freshwater superficial deposits which cover such large areas of country in Argentina and other parts of South America, all belong either to existing genera, and in some cases even species, of American monkeys, or to extinct types of the same great family.

At the time when the huge ground-sloths known as megatheres and mylodons roamed over the pampas of South America, the forests of Brazil re-echoed as now with the cries of howling monkeys, apparently identical with the species still living; while titis and sapajous are known to have existed at the same epoch, and remains of other living genera will doubtless also be found in the same deposits, which belong to the Pleistocene period. At the same time, with these existing genera there also lived an extinct genus of monkeys, known as *Protopithecus*. These monkeys appear to have been nearly related to the modern howlers, but were considerably larger than any living American monkey. In Argentina and Patagonia remains of monkeys apparently related to the *Cebidæ* occur in much older strata, which are probably equivalent to the Miocene of Europe; these have been described under a number of generic names, such as *Homunculus* and *Anthropops*, and have been assigned to a separate family. Marmosets are likewise represented in the superficial South American deposits.

MARMOSETS

THE last, and at the same time the smallest, of all the true Primates are the tiny and beautiful creatures popularly known as marmosets and tamarins. These elegant little animals, many of which are much smaller than a squirrel, are confined to South and Central America, and, although agreeing in many points with the American monkeys (*Cebidae*), yet differ in so many others as to render it necessary to refer them to a distinct family, the *Hapalidae*.

The most important point by which marmosets are distinguished from the American monkeys relates to their teeth. It will be remembered that the American monkeys are distinguished from all their Old World cousins by having thirty-six in place of thirty-two teeth, the increase being due to the presence of an additional bicuspid or premolar on each side of each jaw. Now, if we take the skull of a marmoset and count its teeth, we shall find that their number is the same as in the Old World monkeys, namely, thirty-two. If, however, we compare the cheek teeth with those of an Old World monkey, we shall find that there is a very important point of difference. Thus, whereas in an Old World monkey there are on each side of both the upper and the lower jaw two bicuspids or premolars (teeth which are preceded by milk teeth) and three molars, in a marmoset there are three premolars and only two molars. That is to say, in place of there being two cheek teeth with one pair of cusps on the crown, which are preceded by milk teeth, and three teeth with four cusps which are not so preceded, there are three of the former type and only two of the latter. Although, then, a marmoset agrees with an Old World monkey in the total number of its teeth, yet in the much more important character of the number of premolars it resembles an American monkey, from which it differs in the comparatively unimportant feature of the loss of the last molar in each jaw. A marmoset may, indeed, be defined as a small American monkey which has lost its wisdom teeth; and the dentition of these animals may be expressed by the formula $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{2}{2}$; total 32.

The next most important feature in which the marmosets differ from the true American monkeys is that, with the exception of the great toe, all their fingers and toes are furnished with pointed claws, instead of more or less flattened nails; this character, like the presence of the additional premolar tooth in each jaw, clearly allying them to the lower types of mammals. It is in this group, moreover, that we for the first time find the tail ringed with alternate dark and light bands; a feature occurring also in the lemurs, and in some of the lower mammals. As in the American monkeys, the thumb of the hand cannot be opposed to the fingers, neither are there naked callosities on the buttocks, nor pouches in the cheeks. None of the marmosets has a prehensile tail. The hind limbs are always considerably larger and more robust than the front ones, and the great toe

is invariably of such small dimensions that, in a literal sense of the term, it has no sort of right to its name.

Many marmosets have the ears fringed with long pencils of hairs, which give them a very peculiar and unmistakable appearance. Both in size and habits they are more like squirrels than monkeys, and climb in the same way. They are, indeed, essentially arboreal animals, subsisting not only on fruits, but likewise to a large extent on insects. As mentioned later, marmosets usually live in small parties, and all of them appear to be gentle in disposition, although frequently requiring a considerable amount of trouble and patience before they can be tamed. Whereas other monkeys usually give birth to a single young one at a time, marmosets normally have litters of two or three, and in this respect, therefore, show decided signs of affinity with animals of inferior rank in the zoological scheme. They retain, however the expressive and mobile faces characteristic of the higher monkeys.

There is a large number of kinds of marmosets, although there is still some uncertainty as to how many are entitled to rank as valid species. All of them are very similar in appearance, but they may be conveniently divided into two genera, according as the lower tusks, or canine teeth, are or are not longer than the front teeth, or incisors.

SHORT-TUSKED MARMOSETS

The marmosets of this group are characterised by the tusks not being longer than the incisors in the lower jaw, so that all the teeth present an even series. It is only in this genus (*Hapale*) that we meet with species in which the hair of the tail is marked by darker and lighter rings.

THE OUISTITI MARMOSET

The ouistiti, or common, marmoset (*Hapale jacchus*), is one of the best known of the family, having been described by Linnaeus (page 271). It is an inhabitant of Brazil, more especially of the south-eastern regions, and belongs to a group in which the ears are large and bald over the greater part of their expanse, but furnished with a pencil of long hairs, which forms an expanded tuft on the front edge of their aperture; the hair on the sides of the crown of the head being likewise elongated. The tail is alternately ringed with bands of black and white, and the back has likewise darker and lighter cross-bands.

The ouistiti marmoset is of a generally blackish colour, but the back and outer surfaces of the thighs are marked with transverse bands of grey, and the head has a white spot on the upper part of the nose. The especial point of distinction, however, is that while the head is black and white, the tufts of hair on the ears are pure white.

SHORT-TUSKED MARMOSETS

The contrast between the black face and the white ear-tufts gives a very peculiar expression to this species, reminding us somewhat of a white-haired negro. It is frequently brought to England as a pet.

Bates, who compares the ouistiti to a kitten, banded with black and grey all over the body and tail, and having a fringe of long white hairs around the ears, only observed this marmoset in the neighbourhood of Para. On a certain occasion he observed one comfortably seated on the shoulders of a mulatto girl, whom he met walking in Para, and, on inquiry, learnt that it had been captured in the island of Marajo, at the mouth of the Amazon.

Another closely allied form from Brazil has been named the white-necked marmoset (*H. albicollis*), and is distinguished from the common kind merely by the circumstance that the hind part of the head and the back of the neck are grey instead of black.

In South-Eastern Brazil there is a third nearly related kind known as the black-eared marmoset (*H. penicillata*). The distinctive feature of this creature is to be found in the fact that not only the whole of the head and neck, but likewise the tufts of long hairs on the ears, are completely black. It is, however, doubtful whether either of these is more than a variety of the common species.

There are still other varieties or species, differing somewhat from any of the above in the colouring of the head and ears.

THE WHITE-EARED MARMOSET

The white-eared marmoset (*H. aurita*), which is also a Brazilian species, is the representative of a second group, in which the pencil of hairs on the ears is much more slender than in the common marmoset, while the hair on the back is generally somewhat speckled, although faint traces of banding are occasionally observable. The tail is ringed like that of the common marmoset.

The general colour is blackish, minutely speckled with yellow or a reddish tint on the back, the sides



THE OUISTITI MARMOSET
Photograph by W. S. Berridge



THE BLACK-EARED MARMOSET
Photograph by W. S. Berridge

of the head, the limbs, and the hind part of the body being pure black; while the crown of the head is brown, and a spot on the forehead, as well as the tufts on the ears, grey. In some instances, where the back is more decidedly red than usual, there are faint, paler cross-bands in this region, and more especially on the loins.

The white-shouldered marmoset (*H. humeralifer*) is a closely allied Brazilian kind, distinguished by the face, shoulders, chest, and arms, as well as the tufts on the ears, being white; the thighs being a mixture of brown and white in colour.

THE SILVER MARMOSET

With the silver marmoset (*H. chrysoleucus*) of Brazil we come to the first of a small group of species distinguished from those yet noticed either by the absence of rings of colour on the tail, or by the arrangement or absence of the longer hairs on the ears. They are all tiny, not much larger than a rat, and have no bands of colour on the back.

The silver marmoset has large and nearly naked ears, covered on both sides near the margin with long hairs, forming a double fringe instead of a pencil. The fur of this elegant creature is soft and silky, and either pure white or yellowish white in colour. In the white variety the limbs and tail, however, are invariably yellowish; while in the variety in which the fur of the body is yellowish, that covering the limbs, tail, and under parts may be chestnut brown. These two varieties have been regarded as distinct species.

THE BLACK-TAILED MARMOSET

The black-tailed marmoset (*H. melanura*) is distinguished from the preceding by the absence of the fringe of hairs on the large and flesh-coloured ears, and likewise by the black tail. Usually the general colour of the fur is ashy brown, paler on the front of the body, and whitish on the front of the thighs and loins, while the head and limbs are dark brown (page 272). There is, however, a variety which is entirely white, with the exception of the characteristic black tail.

Of this species, which he mentions under the name of *Midas argentatus*, Bates observes that it is one of the rarest of the American marmosets. "Indeed,

I have not heard of its being found anywhere except near Cameta, where I once saw three individuals, looking like so many white kittens, running along a branch in a cacao grove; in their movements they precisely resembled *M. ursulus*," of which a description is given later. "I saw afterwards a pet animal of this species, and heard that there were many so kept, and that they were esteemed as great treasures. The one mentioned was full-grown, although it measured only 7 in in length of body. It was covered with long, white, silky hairs; the tail being blackish and the face flesh-coloured. It was a most timid and sensitive little thing. The woman who owned it carried it constantly in her bosom, and no money would induce her to part with her pet. She called it Mico (the native name of these animals). It fed from her mouth, and allowed her to fondle it freely, but the nervous little creature would not permit strangers to touch it. If anyone attempted to do so, it shrank back, the whole body trembling with fear, and its teeth chattered whilst it uttered its tremulous frightened tones. The expression of its features was like that of its more robust brother, *M. ursulus*; the eyes, which were black, were full of curiosity and mistrust, and were always kept fixed on the person who attempted to advance towards it."

THE PIGMY MARMOSET

A third representative of the diminutive species constituting this group is the pigmy marmoset (*H. pygmaea*), found in the primeval forest regions of Brazil. This species is distinguished by the smallness of its short ears, which, although slightly hairy on their outer surface, have no tuft or fringe of long hairs, and are entirely concealed beneath the backwardly directed and elongated fur of the crown of the head. A further distinction is to be found in the presence of darker and lighter rings on the tail. The general colour of the body is a tawny or ferruginous brown, more or less varied with black and red on the back; the neck, under parts, and inner surfaces of the limbs being yellowish, and the hands and feet yellowish brown.

The pigmy marmoset, which is not uncommon on the Upper Amazon, at San Paulo, near Ega, measures only 7 in. in length, exclusive of the tail. The tiny face is furnished with long brown whiskers, brushed back over the ears; the general colour of the body being brownish tawny, but the tail elegantly ringed with black. This marmoset ranges as far north as Mexico, and is one of the few South Amazonian

members of the Primates that wanders far from the great river plain; a second being the Silky Marmoset, which has also been recorded from Mexico.

LONG-TUSKED MARMOSETS

The marmosets of this group (genus *Midas*) are distinguished from those of the preceding genus by the fact that the tusks, or canine teeth, of the lower jaw are considerably longer than the front, or incisor teeth; so that the whole series of lower teeth does not present the even and regular height characteristic of the short-tusked marmosets. None of the tamarins, as Buffon named these creatures, has pencilled ears; neither have they ringed tails, although some of the species have the back marked with dark and light cross-bands.

THE NEGRO TAMARIN

One of the best-known species is the common or negro tamarin (*Midas ursulus*), found in Guiana and the lower part of the Amazon valley. It belongs to a group in which both the forehead and face are hairy, and the hair of the head is not longer than that of the body, the ears being large and naked. The colour is nearly uniform black, especially on the nose, lips, and hands; but the hind part of the body has the fur more or less mottled with greyish white. Although not known as a distinct species at the time of Linnæus, this marmoset was described by the early French naturalists and distinguished by Buffon as the *tamarin nègre*.

Bates mentioned that the negro tamarin "is never seen in large flocks, three or four being the greatest number observed together. It seems to be less afraid

of the neighbourhood of man than any other monkey. I sometimes saw it in the woods which border the suburban streets of Para, and once I espied two individuals in a thicket behind the English consul's house at Nazareth. Its mode of progression along the main boughs of the lofty trees is like that of the squirrel; it does not ascend to the slender branches, or take the wonderful flying leaps which the cebidæ do, whose prehensile tails and flexible hands fit them for such headlong travelling. It confines itself to the larger boughs and trunks of trees, the long nails being of great assistance to the creature, enabling it to cling securely to the bark; and it is often seen passing rapidly round the perpendicular cylindrical trunks. It is a quick, timid, restless little creature, and has a great share of curiosity, for when a person passes



THE BLACK-TAILED MARMOSET
From the "Proceedings" of the Zoological Society

LONG-TUSKED MARMOSETS

by under the trees along which a flock is running, they also stop for a few moments to have a stare at the intruder. In Para, *M. ursulus* is often seen in a tame state in the houses of the inhabitants. When full grown, it is about 9 in. long, independently of the tail, which measures 15 in. The fur is thick, and black in colour, with the exception of a reddish brown streak down the middle of the back. When first taken, or when kept tied up, it is very timid and irritable. It will not allow itself to be approached, but keeps retreating backwards when anyone attempts to coax it. It is always in a querulous humour, uttering a twittering, complaining noise, its dark, watchful eyes, expressive of distrust, observant of every movement which takes place near it. When treated kindly, however, as it generally is in the houses of the natives, it becomes very tame and familiar. I once saw one as playful as a kitten, running about the house after the negro children, who fondled it to their hearts' content. It acted somewhat differently towards strangers, and seemed not to see them seated in the hammock which was slung in the room, leaping up, trying to bite, and otherwise annoying them. It is generally fed on sweet fruits, such as the banana; but it is also fond of insects, especially soft-bodied spiders and grasshoppers, which it will snap up with eagerness when within reach. The expression of countenance in these small monkeys is intelligent and pleasing. This is partly due to the small facial angle, which is given as 60° ; but the quick movements of the head, and the way they have of inclining it to one side when their curiosity is excited, contribute very much to give them a knowing expression."

THE RED-HANDED TAMARIN

The red-handed tamarin (*M. rufimanus*), the true tamarin of Buffon, is an inhabitant of Dutch Guiana, or Surinam, and differs from the preceding in its yellowish or orange fed hands, its habits being, doubtless, precisely similar. Like the negro tamarin, it has been exhibited alive in England.

THE BROWN-HEADED TAMARIN

The brown-headed tamarin (*M. fuscicollis*) is the Brazilian representative of several species or races distinguished from the two preceding species by the face being brownish, with a few grey hairs, though the nose still remains black. The colour is black, with a white mottling on the hind part of the back, the head being pale brown, with black

markings. In the male the outer surface of the limbs generally has a bright rufous tinge, while the under parts and the inner surfaces of the limbs are reddish brown. The so-called black-and-red tamarin (*M. rufoniger*) appears to be only a brighter-coloured variety of this species, in which the back, loins, thighs, and legs are of a bright chestnut red. It occurs in Brazil, and has been met with on the Upper Amazon in the neighbourhood of Ega. In referring to the marmoset provisionally identified with this form, Bates wrote: "One day, whilst walking along a forest pathway, I saw one of these lively little fellows miss his grasp as he was passing from one tree to another along with his troop. He fell head-foremost from a height of at least fifty feet, but managed cleverly to alight on his feet in the pathway; quickly turning round, he gave me a good stare for a few moments, and then bounded off gaily to climb another tree." The habits of this species are precisely similar to those of the negro tamarin.

Deville's tamarin (*M. weddelli*), from Peru, is another nearly related species, with the head, neck, front of the back, fore limbs, and tail black; the hind part of the back marked with grey and black transverse bars, and the loins and legs bright chestnut red.

MOUSTACHED TAMARIN

The little moustached tamarin (*M. labiatus*) belongs to a well-marked small group of species recognised by having the tip of the nose and the lips covered with white hairs, giving a very peculiar look to the face. It is found in the Upper Amazon valley, both in Brazil and Peru, and is black, with a brownish tinge

on the back and thighs, the white hairs on the nose and lips being long and forming a broad tuft. When seen from a short distance, it looks as though it were holding a ball of snow-white cotton in its teeth.

The red-bellied tamarin (*M. rufiventer*) is an allied Upper Amazonian species, with a very smooth and glossy coat of a deep blackish brown colour on the back, while the under parts are a mixture of rich black and reddish hues. The white hairs on the nose and lips are much shorter and less conspicuous than in the moustached tamarin, those on their lips merely forming a thin line on the margins instead of a distinct tuft.

THE PINCHÉ

In Colombia (New Granada) and Panama the tusked marmosets are represented by two closely allied species differing in certain points from all



DEVILLE'S TAMARIN
Photograph by W. P. Dando



THE PINCHÉ MARMOSET
Photograph by W. S. Berridge

those found in the more southerly or easterly regions. Both have the face and sides of the head sparsely haired, while there is a distinctly marked patch of hair, different from the rest, on the crown of the head, and the hair on the neck is elongated.

The present species is restricted to Colombia, and has been long known in Europe; it received its name of pinché—on what grounds I know not—from Buffon. It is of a greyish brown colour on the back; the outer surface of the limbs and the root of the tail being tinged with red, while the long tuft of hair which forms a crest on the top of the head, as well as the throat, under parts, arms, and the front of the legs, are white; the tip of the tail being black.

Geoffroy's marmoset (*M. geoffroyi*), which is the representative of the pinché in Panama, is distinguished from that species by the hair on the crown of the head not being elongated into a crest, but being short, and forming a narrow patch of an oblong shape (page 275). Its coloration is nearly the same as that of the pinché, excepting that the hair on the nape of the neck is chestnut-coloured.

THE SILKY MARMOSET

The last group of the marmosets is represented by the silky marmoset (*M. rosalia*) and the golden-headed marmoset, both of which inhabit the forests of South-Eastern Brazil, and are commonly exhibited in the menageries of Europe. They are distinguished by having the head and part of the neck covered with long hair, forming a kind of mane, the hair round the face being directed backwards. The face itself is only sparsely haired, and the naked ears are partly concealed by the mane. The colour is a golden yellow, more or less tinged with red; but there is a variety in which the head, hands, feet, and the end of the tail are blackish.

The silky marmoset (page 167) was known to Buffon under the name of the marikina, and has also been described as the lion marmoset (*M. leoninus*), a name due to the long mane of brown hair

hanging from the neck and giving it somewhat the appearance of a miniature lion. Bates mentions that he saw a tame individual of this species on the Upper Amazon. After commenting on its playful and intelligent disposition, he observes that it was familiar with every person in the house where it was kept, and seemed to take particular pleasure in climbing about the bodies of the various visitors who entered. "The first time I went in, it ran across the room straightway to the chair on which I had sat down and climbed up to my shoulder; arrived there, it turned round and looked in my face; showing its little teeth, and chattering, as though it would say, 'Well, and how do you do?'" It showed more affection towards its master than towards strangers, and would climb up to his head a dozen times in the course of an hour." These marmosets are described as keeping to the very top of their cages—a habit probably retained from the native one of living in the tree-tops. When descending they always come down backwards, with the tail pendent. Their ways are very similar to those of the common marmoset, but they are reported to have a habit of bounding from tree to tree with incredible rapidity, which is scarcely consonant with the account generally given of the movements of marmosets. They are stated to utter sharp but weak cries of alarm when frightened. The total length of this marmoset is rather less than two feet, of which one is occupied by the long tail.

The golden-headed marmoset (*M. chrysomelas*) may be regarded as a black representative of the silky species, its general colour being black, with the face, forearms, hands, feet, and the base of the tail tawny

R. LYDEKKER

STORIES OF THE MARMOSETS

Marmosets are not uncommon pets in England. With warmth and abundant variety of diet they are not difficult to keep. One lady frequenter of the



THE SILKY, OR LION, MARMOSET
Photograph by W. S. Berridge

London Zoological Gardens carries in her muff a tiny marmoset, which, in warmer weather, makes itself snug in a cunningly contrived pocket in the lady's belt, where it is hidden by a feather boa or lace ruff. In these days of painful realism in lady's

furs and other articles of apparel it is hard to tell whether this living marmoset may not be merely some particularly extravagant fad of adornment.

The marmoset is not so intelligent a pet as many other members of the order to which it belongs. Its relatively big brain has not been cultivated to the same extent as have been the brains of other primates. Even so, it is apt to incur censure which it should escape. The female of a pair in captivity gave birth to three young ones. She bit off the head of one of them. The others managed to make their way close to her, where she at once fed them. Thereafter she proved the best of mothers, while the male, when the feeding was over, showed his paternal devotion by taking the little ones on his back or under his body, where they remained until they whined for another meal.

The observant owner of these marmosets attributed the destruction of the marmoset to the inexperience of the dam, to whom the cares of maternity were new. That explanation, however, will not do. The probability is that the animal killed her offspring because she was under observation. Long as the rabbit has been domesticated, the mother will destroy her young if she be interfered with during the first few days following their birth. A sow will destroy her litter for the same reason. Not inexperience drove the marmoset to her deed, but discontent with her surroundings, and the consciousness of her accessibility. Later litters met a similar fate, because, it is to be presumed, the dam remembered how she had used the first. There is always a danger, when an animal has once destroyed a litter, that a similar course will be pursued with regard to later offspring.

Frank Buckland managed to keep a marmoset in happiness. She occupied a squirrel's cage at one end of the mantelpiece of his study, while a lusty rat was the tenant of another at the opposite end. Being nocturnal, they remained inactive during the day, but, as night fell, they emerged from their cages. The two animals would meet on neutral territory midway between the two cages, where the marmoset would make some pretence at recognition, while the rat, with a supercilious toss of his nose, would merely acknowledge the salutation, and pass on his way. The programme never varied. The rat would go straight to the vacant cage of the marmoset and steal the food which the tenant had left behind, consisting of grapes, sugar-plums, meal-worms and what not. In the meantime, while her own premises were being ravaged, the marmoset was quietly robbing the home of the rat. Once the rat, despatching his booty hurriedly, returned unexpectedly to his cage and found the marmoset there, and attacked her so fiercely that Buckland had to interfere to save her from serious injury.

Experience failed to make this marmoset wise. She would hang for hours sloth-like from the gas-bracket. Every now and then she would whisk her tail into the flame, and as quickly whisk it out again. She never got over the habit, and the consequence was that her tail at last became quite bare. If anybody could have tamed a marmoset



GEOFFROY'S MARMOSET

From the "Proceedings" of the Zoological Society

that man surely was Buckland, but, whenever he attempted to pick her up, or even to touch her, she glared at him and screwed up her face into the nearest resemblance to ferocity to which she could attain, to the intent that terror might seize him and she escape his hand. Her voice on these occasions he compared to a watch whose mainspring had suddenly snapped. Probably his monkeys would have given the marmoset a very uncomfortable time could they have had her in their cage, but when they heard her cries of protest they always did their best to go to her rescue, shaking the bars and making the most fearsome grimaces at their master, who never harmed them, but whom they now judged guilty of assault and battery upon their cousin.

The South American natives make pets of the marmosets, as we have seen. One extraordinary means of keeping them has not been mentioned. A tiny tamarin (*Midas illigeri*) made its home on the head of the woman to whom it belonged, concealed within her luxuriant tresses. Having become tame, it was wont to hop out to feed, or, having captured a spider or two, it would scamper back again and hide under the abundant locks of its owner. Imagination suggests that this is an unpleasant method of housing a pet.

E. A. B.

CHARACTERS OF THE LEMUROIDS

ALL the animals treated of in the preceding sections as possessing many characters in common are regarded by naturalists as collectively constituting one great group of the Primates. And since this group is also taken in zoological classification to include man himself, it is spoken of as the Anthropeidea, or man-like group, the individual members thereof being referred to as anthropoids.

We now come to another and lower group of animals, which, while sufficiently nearly allied to the above to be included in the order, are yet so different as to be entitled to stand as a group of equivalent rank. These animals are primarily represented by the lemurs and lorises; but the group also includes two other creatures which form the types of two families by themselves. As it is desirable to have a common name for all the members of this group, and as it would be incorrect to allude to the whole of them as lemurs, the term lemur-like creatures, or, shortly, lemuroids, will be found convenient.

Although these lemuroids may always be distinguished at a glance from the apes and monkeys by their foxy, expressionless faces, it is difficult to point out the important structural features by which they differ from the former without entering into anatomical details unsuited to a popular work. In spite, however, of these differences, there are such resemblances between the two groups as to suggest that the lemurs and their allies are not far removed from the group from which we may presume apes and monkeys to have originated.

Considerable diversity of opinion has obtained among naturalists as to the affinity of lemuroids. As the result of the study of a large series of remains of extinct lemuroids from Madagascar, Mr. H. F. Standing and Dr. Elliot Smith consider that there is no justification for regarding the Anthropeidea and the Lemuroidea as distinct groups, since some of the extinct Malagasy forms are intermediate between the two. On the other hand, Professor A. A. W. Hubrecht, as the result of the study of their embryological development, is of opinion that lemuroids should not be included in the same ordinal group as anthropoids.

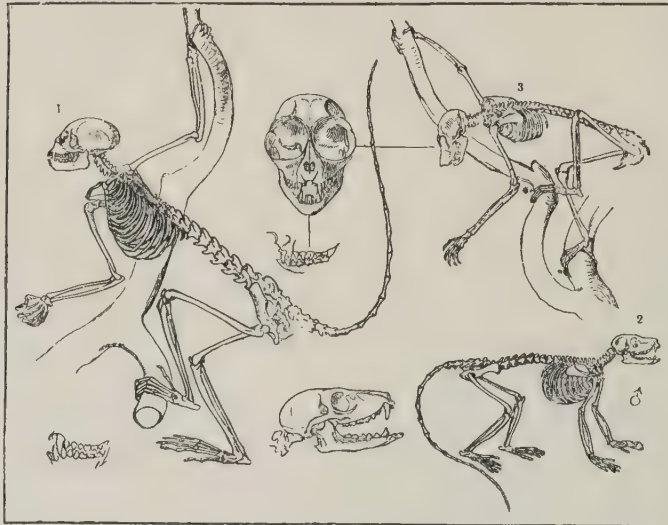
That the lemurs are much lower in the zoological scale than the apes and monkeys is shown by the

simpler structure of their brains, which have far fewer foldings on their surface than is the case with those of the latter; the amount of such foldings, as giving a larger extent of superficial surface, being indicative of the mental powers of the owners of the brains.

A peculiar feature of all the lemurs and their allies is to be found in the fact that the second toe of the foot (corresponding to the index finger of the hand) is always furnished with a sharp claw. All lemurs have a well-developed thumb and great toe; but, curiously enough, in some of them the index finger of the hand is rudimentary. They may or may not have tails, but these are never prehensile, although, as in some of the marmosets, they may be marked by alternate dark and light rings.

A point of resemblance to the monkeys and apes is shown in the number of incisor, or front, teeth being very frequently two on each side of both jaws, in place of the three which are so commonly present in other mammals. In the apes and monkeys, however, the central pair of incisors in the upper jaw are in contact with one another, while in the lemurs they are almost invariably separated by a gap in the middle line. This affords a ready means of distinguishing the skull of a lemur at a single glance from the skulls of almost all other mammals, except bats and some of the Insectivora. The lower front, or incisor, teeth of the lemurs shelve forwards, after the manner already mentioned as characteristic of one group of the American monkeys (page 260).

Many lemurs are purely nocturnal animals, and it was probably from this circumstance, coupled with their silent habits and stealthy movements, that Linnæus was induced to give them the name by which they are now universally known. The name "lemur" is taken from the Latin *lemures*, which, together with that of *larvæ*, was applied by the ancient Romans to such "shades of the dead" as were supposed to be of malignant propensities. It is curious that both terms should have been introduced into



SKELETONS OF SQUIRREL MONKEY (1), MUNGOOSE LEMUR (2), AND SLENDER LORIS (3)

zoological nomenclature—the former to denote the animals of the present group, the latter the grub stage of insects.

Altogether, there are about fifty living species of lemur-like animals, all restricted to the southern regions of the great land masses of the Old World,

THE LEMURS



THE YELLOW-WHISKERED
VARIETY OF FULVOUS LEMUR

none being found to the north of the Tropic of Cancer, while the Tropic of Capricorn very nearly limits their southward range. Within this area a few species are found respectively throughout the warmer regions of Africa and in Southern India and Ceylon, while their eastern limits are marked by the island of Celebes and the Philippines. In all these regions the number of species is comparatively few, and they form but an unimportant element in the general fauna. The case is, however, very different in Madagascar, the headquarters of the whole group. Here they constitute no less than one-half of the entire mammalian fauna of the island, being represented by about six genera, which include more than thirty

species, most of the other mammals of the island being comparatively small forms, unknown either on the continent of Africa or in Asia. The true lemurs occur only in Madagascar, and it is very remarkable that all the species of the group found in that island scarcely show any closer relationship to those of the African mainland than they exhibit to those of Asia. So abundant, indeed, are lemurs in Madagascar that at least one individual is almost sure to be found in every little copse throughout the island.

Almost all of the lemurs are essentially of arboreal habits. Indeed, except when compelled to descend to the ground to obtain water, or for the purpose of crossing from one plantation or coppice to

another, they but rarely leave the trees. Their diet is extremely mixed, scarcely anything coming amiss to them, leaves, fruits, insects, reptiles, birds' eggs, and birds being eagerly consumed by most of these animals.

By the natives of Madagascar lemurs are looked upon with superstitious awe, and are consequently seldom molested. This is doubtless due to their nocturnal habits and ghost-like movements, while the large eyes essential to these and all other nocturnal creatures have perhaps contributed to this feeling. In Ceylon and India, as we shall learn, the large glaring eyes of one of the prettiest of the lemuroids used to lead to the unfortunate creatures being put to a cruel death. None of the existing lemuroids attains any very large size, and

all, when unmolested, are harmless and inoffensive, except to the birds, reptiles, and insects upon which they prey. The nostrils of a lemur, which are always situated at the extremity of the muzzle, differ markedly in form from those of a monkey. In all the latter, whether they be thin-nosed, like the Old World kinds, or broad-nosed, like those of America, the nostrils are always more or less rounded in form, and thus approach to the human type. In lemurs, on the other hand, the nostrils are always in the form of curved slits, widest above, and with the convexity directed outwardly. The nostrils are, in fact, almost precisely similar to those of a dog or a cat, and we have in this another proof of a relatively low zoological position.



THE BROWN VARIETY OF
THE BLACK LEMUR

THE LEMURS

IN the true, or typical, lemurs (family *Lemuridae*), which are exclusively confined to Madagascar, the first point to be noticed is that the upper front, or incisor, teeth are always two in number on each side of the jaw, and that the middle pair are separated from one another by a gap. The upper premolar teeth may be either two, as in the Old World monkeys, or three, as in their cousins of the New World, the molars being invariably three in number. The front teeth in the lower jaw, together with the one corresponding to the tusk, or canine, always shelf forwards, and are small. This small size and shelving direction of the lower tusks render it necessary that some other tooth should be enlarged so as

to bite against the upper tusk. Accordingly, the first premolar in the lower jaw takes on the form and size of a tusk, and bites against the true tusk, or canine tooth of the upper jaw. It has been mentioned in an earlier page (141) that whereas true tusks, or canines, have usually only a single root, premolar teeth nearly always have two roots, except when there are four of these teeth, in which case the first generally has but one root. Now, the tusk-like lower premolar of the lemurs has the usual two roots, and hence we have a ready means of distinguishing a lemur's skull from that of most other mammals; that is to say, by the lower tusk having two distinct roots.

Another distinctive feature of the true lemurs is that, with the exception of the second toe of the foot, all the fingers and all the toes have well-formed flattened nails like those of the majority of monkeys.

It is also important to notice that all the Malagasy lemurs, inclusive of the aye-aye, agree with one another in regard to the structure of the drum, or tympanum, of the ear, and thereby differ markedly from the lorises and galagos.

THE INDRI

The peculiar-looking indri (*Indris brevicaudata*) is one of the numerous lemuroids from Madagascar, and occupies the position of being the largest member of the entire group. It is likewise the sole representative of its genus. The name indri, or indris, is a corruption of the native name endrina, applied in certain districts to this animal. In other districts, however, it is designated baba-koto, or "little old man."

The indri is the first of a group of three genera which present certain characteristics in common not found in other lemurs; the members of these three genera are accordingly grouped together in a separate subfamily—the *Propithecinae*. Among these characters the most obvious is the large proportionate size of the legs as compared with the arms. Another is that, with the exception of the great toe, which is capable of being fully opposed to the others, the toes of the foot are joined together by webs as far as the end of the first joints. The total number of teeth in the adult condition is limited to thirty, the series being represented by the formula $i.\frac{3}{1}, c.\frac{1}{1}, p.m.\frac{2}{2}, m.\frac{3}{3}$. All the members of this group differ from the other lemuroids in that they do not give birth to more than a single young one at a time. From this circumstance, together with certain features in their structure, these indris are regarded as the most highly organised of all the lemurs, and are accordingly placed at the head of the list. They subsist exclusively on a vegetable diet.

The indri is sufficiently distinguished from the other two genera included in the group by its mere stump of a tail, although there are also certain other features which support its right to stand as the representative of a distinct genus.

As already mentioned, the indri is the largest of the lemurs, and in a fully adult animal the length of the head and body is about two feet. Although there is great individual variation in this respect, the indri is very strikingly coloured. Very frequently the forehead is blackish, but, like the cheeks and throat, it may be grey. The head, shoulders, back, and arms are of a full velvety black, and the black ears are large and prominent and covered with longer hairs than those on the head. From the loins to the tail there is a large triangular patch of either pure white or of a yellowish tinge; this patch terminates in front in a sharp point, and is bordered on all sides with black. The flanks are also light-coloured, and the dark bands which usually separate the light area of the loins from that of the flanks are continued down the front of the legs;

but the sides of the legs are in general whitish, and their hind surface is grey, the heel being reddish. The hands and feet are black, and, as a rule, almost denuded of hair.

Such are the common colours in the larger number of specimens of the indri. In almost every drove, however, individuals are found in which the light-coloured areas intrude more or less extensively upon those which are usually black; and from these intermediate forms a complete transition can be traced to others in which the whole of the fur is white. The intermediately coloured individuals very generally retain the broad black streak down the front of the leg, and the black ears.

Instead of being distributed over the whole of Madagascar, the indri is confined to the forests on the east coast, this restricted distribution being due to the great range of mountains running longitudinally through the island, which cuts off these animals from the plains on the western side.

In contradistinction to most of the lemurs, the indris are purely diurnal in their habits, and are commonly found in small parties of four or five, although during the day single individuals, more or less widely separated from their companions, may frequently be seen. Their general habits appear to be similar to those of their near relatives the sifakas. Unless injured so badly as to be unable to make its escape, an indri does not give utterance to the least sound when wounded; if, however, it is so severely hit as to fall to the ground, which it will only do when its extraordinary powers of holding on to the branches of the trees are exhausted, it gives vent to piercing shrieks.

THE SIFAKAS

The sifakas, as they are called by the native inhabitants of Madagascar, constitute the only genus (*Propithecus*) of the present group of lemurs which is represented by more than a single species. Although closely allied to the indri, they are distinguished by their long tails; the muzzle is also rather shorter, and the ears are considerably smaller, and partly concealed by the fur. Their skin is of a deep black; but the general colour of the fur is usually white, more or less tinged with yellow, and, in some individuals, passing into red or even black. The fur on the breast is always much thinner than that of other parts of the body.

Three species of the genus are recognised, which are restricted to different parts of the island; but of these species there are several more or less distinct races, which are likewise confined to particular localities. It has been observed that while those individuals of the several species which tend to assume a black colouring are found in the damper parts of the island, those which are most completely white frequent the drier regions at the northern extremity of Madagascar.

Sifakas live in bands of from six to eight. They are completely diurnal in their habits, and may be observed at morning and evening, when the heat is not too great, leaping in the forests from tree to tree in search of food. At sunrise they

THE SIFAKAS

may often be seen sitting on the horizontal bough of a tree, close to where it branches off from the main stem, with their long legs bent so as to touch their chins, and their hands resting on their knees. At other times they will be noticed sitting in the same position, but with their arms extended, so as to receive the genial warmth of the rising sun on their bodies. During the heat of the day they conceal themselves in the depths of the foliage. When sleeping, they incline the head forwards on the chest, and cover it with their arms; at the same time the tail is either curled up spirally between the legs or allowed to hang straight down.

Their shelving lower front teeth are admirably adapted for removing part of the rind of the fruits on which they so largely subsist, and thus making an aperture through which the pulp is removed piecemeal. The skins of the fruits are always rejected; and it is stated that sifakas exhibit a marked preference for green rather than ripe fruit.

In all ways they are admirably adapted for a purely arboreal life. So strong, indeed, are their hind limbs that they can readily take leaps of from ten to eleven yards in passing from bough to bough; and so rapid are their motions that they appear to fly rather than leap. On the rare occasions when they descend from their favourite trees, they advance by means of long leaps, as, owing to the shortness of their arms, it is not easy for them to walk on the ground on all-fours like the majority of monkeys. To see them resting on their hind feet, and at each leap throwing up their arms in the air, the spectator might be led to think for a moment that he was looking at children at play. Indeed, a troop of these creatures advancing across the plains in the manner described is said to be a truly ludicrous sight. Not only are the hands of the sifakas of no use to their owners in walking, but they are almost equally useless as organs of prehension; and when a sifaka has occasion to pick up a fruit from the ground, it will usually stoop down and seize the prize in its mouth. When conveyed to the hand, such an object is grasped between the bent fingers and the palm, and not between the fingers and thumb. As grasping organs, adapted to afford a firm hold to the branches of trees, both hands and feet, however, are perfect.

In disposition, sifakas are gentle and seldom attempt to bite, while if they do so the wound they inflict is not serious. At certain seasons, however, the males are wont to engage in contests among themselves, the results of which are frequently visible in their torn and tattered ears. Unlike many other lemurs, they are, as a rule, silent; but when frightened or angry they give vent to a low cry somewhat resembling the clucking of a fowl. In

short, so far as character goes, these animals may be described as being not very active, not very restless, and not very intelligent.

THE DIADEMED SIFAKA

The diademed sifaka (*Propithecus diadema*), known to the natives of Madagascar as the simpona, is the largest of the three species, and the one first brought to the notice of science, having been described by Mr. E. T. Bennett in 1832. It takes its name from the band of white hairs running across the forehead, which, with the grey fringe of hair on the cheeks and chin, surrounds the black face, and thus gives to the animal a peculiar and striking physiognomy. The crown and back of the head, together with the outer surface of the ears and the nape of the neck, are dark brown, and the same tint extends over the shoulders, so as to give somewhat the appearance of a mantle, and ends in a point on the

back, this point in some individuals being only just below the neck, while in others it reaches as far back as the loins. Occasionally this dark mantle-like area, instead of being dark brown, is of a grey tint. The loins and flanks are generally grey, varying considerably in different individuals; the grey passing gradually into the brown of the back and the orange round the tail, and extending on to the upper part of the arms, or even enveloping the whole of the upper arm. The forearms, together with the region round the tail and the legs, are generally of a bright orange yellow, although occasionally yellowish white with some intermixed black hairs. The hands are mainly black, but the feet have a good deal of yellow in them; the basal half of the tail is yellowish, while the rest of it is grey.

Such are the colours of the typical form of this species. In the moist regions of the south of Madagascar, however, there is a nearly or quite

white race of this lemur, while in the dry regions of the north there is a black race, in each case immediate forms occurring which connect these varieties with the ordinary type.

The diademed sifaka inhabits the narrow strip of forest land extending along the whole length of the eastern coast, and bordering the chain of granite and slaty mountains which dips down towards the sea on the east, and is the cause of almost daily rain. It is where this chain almost dies out at the northern end of the island that the black race occurs.

VERREAUX'S SIFAKA

This and the next species, which are smaller than the diademed sifaka, and are those which are known to the natives as sifakas, are restricted to the western and southern coasts of Madagascar. Here they are only found in the thick forests which occur at intervals among the desolate solitudes of the western



THE RING-TAILED LEMUR

and southern sides of the island—regions of sandy plain where fertilising rains seldom occur.

The fur of Verreaux's sifaka (*P. verreauxi*) is woolly and soft to the touch, its colour being typically white with a faint tinge of yellow. The summit and hind part of the head, however, are often of a maroon colour, and more rarely reddish, while some individuals show more or less marked grey tints in various regions of the body. In no case, does the brown area of the head extend on to the neck and back, as it does in the diademed species. There are two well-marked varieties of this species, one being pure white, with the exception of patches of bright red on the arms and thighs.

THE CROWNED SIFAKA

The crowned sifaka (*P. coronatus*) agrees in size with the preceding, to which it is closely allied. It has, indeed, a crest of long blackish hairs on the forehead, from which it derives its name; but, since a similar crest is found in some individuals of Verreaux's sifaka, it is evident that this cannot be taken as the ground for specific distinction. Neither can its colouring, peculiar though it be, form the distinction, since the difference in this respect from the typical race of the latter species is scarcely, if at all, greater than that occurring between the various races included under that heading.

In point of fact the crowned sifaka is ranked as a distinct species, mainly from the characters of the skull, which is altogether larger than that of the preceding species, in addition to which it has a proportionately larger muzzle, besides other distinctive features.

In colour, the forehead, the crown of the head, and the cheeks are blackish brown, in bold contrast to which stands out the white fur with which the ears are covered. The neck and upper parts of the body, as well as the limbs, are of the same white hue, having a more or less distinct rosy tinge on the limbs and at the root of the tail, this rosy tint being most distinct in the more southerly race of this species, in which it may extend on to the back. There is a patch of grey or brown, varying in size, on the nape of the neck. The tail and hands are invariably pure white.

This species is restricted to a small area on the north-west coast of Madagascar, situated to the north-east of Cape St. André, and bounded to the east by the River Betsiboka and by the Manzaray to the west.

Messrs. Milne-Edwards and Grandidier remark how curious it is that the various races and species are so sharply separated from one another that it is sufficient to cross a river—it may be of no great width—in order to find that, while on one bank all the sifakas belong to one race, on the opposite bank they will be of another race, if not

of a distinct species. No satisfactory explanation of these peculiar features in distribution suggested itself to the authors named.

THE AVAHI LEMUR

The third and last genus of the group of lemurs is represented only by the avahi, or woolly, lemur (*Avahis laniger*), a species discovered in 1780, at the same time as the indri, by the French traveller Pierre



THE WHITE-FRONTED VARIETY OF THE
FULVOUS LEMUR

Sonnerat. The avahi, although furnished with a long tail like the sifakas, is distinguished by the still shorter muzzle, and also by the ears being completely concealed by the fur, which is of a woolly instead of a silky nature. Although these differences are ample to distinguish the avahi from the sifakas when they are seen together, it is not on these alone that naturalists rely when referring them to distinct genera. There are, indeed, well-marked differences in their

teeth, but it will be sufficient for our purpose merely to record the existence of these points of distinction. The avahi differs, moreover, from all the other members of the group to which it belongs in being nocturnal instead of diurnal in its habits.

The avahi is the smallest member of all this group of lemurs, its dimensions being rather less than two-thirds of those of the diademed sifaka. In colour, the long hairs on the forehead immediately above the eyes are grey at the base and pinkish at the tips, while there is in some individuals a small white or yellowish band, more or less irregular, across the crown of the head. The rest of the head, the neck, the back, and the arms are covered with woolly fur, of which the hairs are grey at the roots, reddish in the middle, and black at the tips, an arrangement which communicates a peculiar appearance to the whole fur. The concealed ears are reddish and the cheeks grey. The loins and flanks are of a much lighter colour than the back, especially in the region of the tail, where there is a large triangular patch of pinkish white running forwards into the dark area of the body. The hind limbs are still lighter in colour, and, as the hairs here tend to grow into bunches, or tufts, they reveal their grey bases and pinkish tips, thus giving to the fur a mottled appearance. The bushy tail is of a decidedly pink tint, more especially for the first third of its length. The hands and feet are reddish.

There are, however, great variations of colour among different individuals of the avahi inhabiting even the same district, some having the fur almost uniformly reddish, while in others all the parts above the thighs are nearly pure white.

Avahis, instead of living in small troops like indris and sifakas, are found either solitary or in pairs. They are completely nocturnal, sleeping during the day curled up in the fork of a branch, and issuing forth in search of food with the falling shades of

THE TRUE LEMURS

night. Like their allies, they are sluggish in their movements, and seldom descend to the ground, and, when they do so, they walk in the peculiar manner of the sifakas.

The avahis are found in two parallel bands of forest on the east side of Madagascar, and also in the woods of a small area on the north-west, and are totally unknown on the west and south coasts, where the vegetation and climate are quite different. The members of the colony on the north-west coast are of smaller size and somewhat different colouring from those on the east side of the island. From their smaller size and nocturnal habits avahis are less noticed by the natives than are the other members of this group, and do not figure conspicuously either in their legends or their superstitions. The name avahi is the one by which they are known to the Antanala tribe. By other tribes, however, they are termed ampongi, fotsi-fe, or fotsi-afaka, the last two respectively meaning "white legs" or "white fork," in allusion to the peculiar colouring of the hind parts of these animals.

THE TRUE LEMURS

The true lemurs (genus *Lemur*) form the first of a group differing in several respects from those already noticed. The first and most easily recognised feature by which they and their allies may be distinguished from the group containing the indri and the avahi is that the toes of the foot are not connected at their bases by a web. In none of the true lemurs are the legs so long in proportion to the arms as is the case in the members of the preceding group, while all of them have long tails. Then, again, it may be mentioned that the members of this group are distinguished by the presence of an additional front tooth on each side of the lower jaw, and likewise by having one more premolar tooth on each side of both jaws, thus bringing up the total number of teeth from thirty to thirty-six. The formula is $i.\frac{3}{2}$, $c.\frac{1}{1}$, $p.m.\frac{3}{3}$, $m.\frac{3}{3}$; which may be compared with that given above as distinctive of that of members of the indri group of lemurs. They form the subfamily *Lemurinae*.

The true lemurs are confined to Madagascar and the Comoro Islands, situated half-way between the former and Zanzibar. Although some are nocturnal and others diurnal

in their habits, all differ from the indri group in subsisting on a mixed diet, insects, small reptiles, birds' eggs, and the callow young of birds forming at least as important a part of their food as fruits. It is probably owing to this diet that they are of a much hardier disposition than are the members of the indri group, so that they flourish in confinement in Europe so well as not infrequently to breed; the number of young produced at a birth being either one or two.

In consequence of their arms being longer in proportion to their legs than in the indri group, the true lemurs and their allies, when on the ground, are in the habit of going on all-fours, although also capable of taking leaps of great length. The true lemurs may be distinguished from the other members of the group to which they belong by the length of their snouts, and the large size of their tufted ears, as well as by their diurnal habits.

THE RING-TAILED LEMUR

One of the best known of all the true lemurs is the ring-tailed lemur (*Lemur catta*). This animal, which may be compared in appearance to a very small fox, is of an ashy grey colour, darker on the back, and white on the under parts, as well as on the sides of the face, ears, and the middle of the forehead. Its most distinctive feature is to be found in the alternate rings of black and white on the tail, from which it derives its name (pages 261, 279). There is no fringe of long hair round the face.

The ring-tailed lemur is found in the central parts of Madagascar, ranging on the west coast to Mouroundava and on the east to Andrahombe. Like the other members of the group, this lemur lives in small parties, and is most active at early morning and evening, sleeping during the night with its bushy tail curled round its body, and likewise taking a siesta during the heat of the day. Unlike the members of the indri group, it is a noisy creature; and the whereabouts of a troop are discoverable by the loud cries which they are continually uttering.

In captivity this species thrives well, and is generally numerously represented in the Gardens of the Zoological Society in London, although it does not appear that it has ever bred there.

The Rev. G. A. Shaw says that the habitat of the ring-tailed lemur in the south and south-west of Madagascar is among rocks, over which it can travel easily where it is impossible for the people, although bare-footed, to follow. Its palms are



THE BLACK LEMUR



THE BLACK-HEADED VARIETY OF THE FULVOUS LEMUR

long, smooth, level, and leather-like, and enable the animal to find a firm footing on the slippery wet rocks, very much on the same principle as that which assists a fly to walk up a pane of glass. The thumbs on the hind feet are very much smaller in proportion than in the forest-dwelling lemurs, which depend upon their grasping power for their means of progression and spring from tree to tree, rarely, if ever, touching the ground,

except in search of water. Hence the ring-tailed lemurs are an exception to the general habits of the Lemuridae, in that they are not arboreal. There are very few trees near their district, and these few are very stunted and bushy.

THE MUNGOOSE LEMUR

All the remaining species of true lemurs are distinguished from the preceding by their uniformly coloured tails. Among them, the mongoose lemur, or, as it is called by some, the fulvous lemur, (*L. mungos*) was described by Linnæus. It inhabits the north-western coast of Madagascar; and may be known by its black nose and the iron-grey spot on each side of the forehead. The fur is of a somewhat woolly nature and reddish grey in colour; but the face, chin, the middle line of the forehead, and a streak across the crown of the head are black; while the cheeks and the sides of the forehead are grey. There is considerable individual variation in the width of the black band across the head.

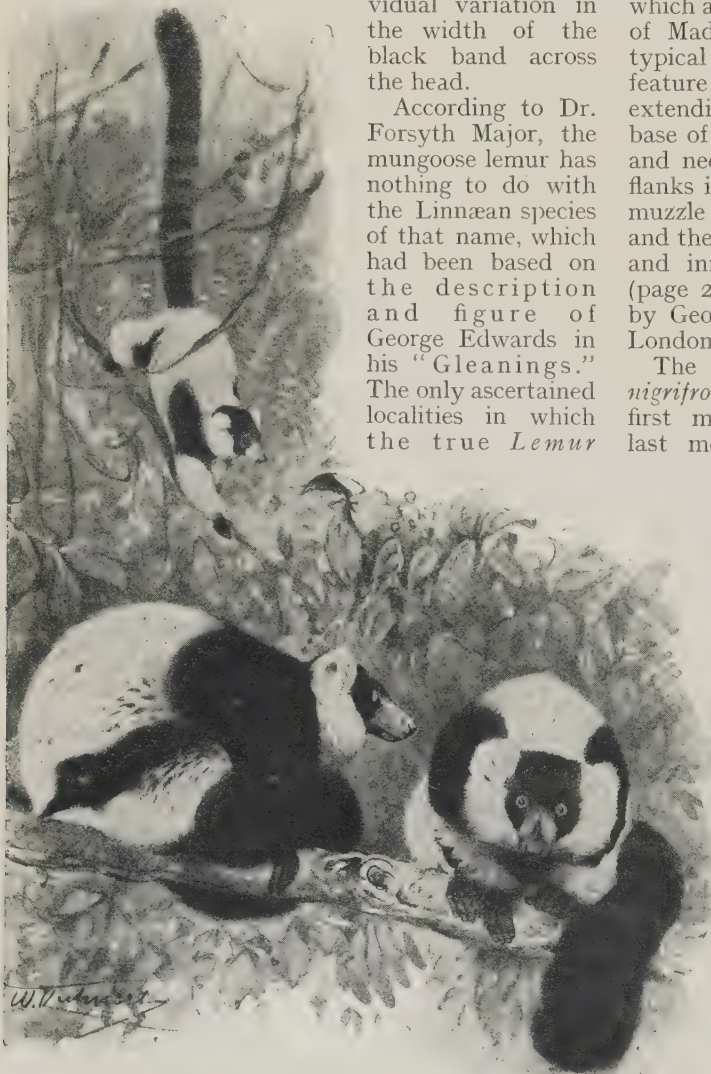
According to Dr. Forsyth Major, the mongoose lemur has nothing to do with the Linnæan species of that name, which had been based on the description and figure of George Edwards in his "Gleanings." The only ascertained localities in which the true *Lemur*

mungos occur are the neighbourhood of the Bembatoka Bay (on the north-western coast of Madagascar) and the two islands Anjuan and Mohilla of the Comoro Group. The earliest available name for the usually so-called *Lemur mungos*—a very variable species, spread over a great part of Madagascar—seemed to be *Lemur fuscus*. The two species, like all the members of the genus, are easily distinguishable by the characters of their skulls. In this work the name generally in use has been retained.

The red-fronted race of this species (*L. mungos rufifrons*) may be easily recognised by the two small white stripes running across each side of the rump. The general colour of the fur is grey; the throat and under parts are reddish; the nose and the middle of the forehead are black; while the sides of the nose, the cheeks, and a large spot on either side of the forehead are white. The tail is blackish, with a reddish tinge at the root.

The white-fronted lemur (*L. mungos albifrons*), which appears to be restricted to the north-east coast of Madagascar, is mainly distinguished from the typical race by its colour; its most distinctive feature being a broad band of white woolly hairs extending across the forehead, and including the base of the ears, the cheeks, and part of the throat and neck. The prevailing colour of the back and flanks is grizzled brown, tinged with red; the long muzzle and face, together with the hands and feet and the end of the tail, being black. The under parts and inner surfaces of the limbs are whitish grey (page 280). This pretty race was first described by Geoffroy St. Hilaire; and was exhibited in the London Zoological Gardens as far back as 1830.

The so-called black-fronted lemur (*L. mungos nigrifrons*) is another race of the same species, also first made known to science by the naturalist last mentioned. In comparing it with the preceding race, Mr. E. T. Bennett, who had the opportunity of seeing living examples of both, observed that "their size is nearly equal, and there is little, if any, difference in their form; but their colours, invariable as we have hitherto found them, furnish sufficient ground for regarding them as distinct. The present animal has the elongated muzzle of the last, but the black colour embraces in it the forehead and sides of the face, as well as the base of the muzzle; and the hair on the former parts, instead of being long and woolly, is short, smooth, and even. While the black is thus extended backwards over the head, it is bounded on the fore part of the muzzle, which, instead of being uniform in colour, as in the preceding species, becomes grizzled towards its extremity, and at last almost white. The general colour of the upper parts of the body is dark ashy grey, most of the hairs terminating in tawny tips, which are so strongly marked on the back as to give a decided tinge. The tail is light grey at the base, and darker towards the tip; the outside of the



RUFFED LEMURS

THE GENTLE LEMURS

limbs is of a light ashy grey; the chin, chest, and throat are pure white; and the under parts, together with the inner side of the hind limbs, pale rufous. The hands, which are blackish, have the same tendency to become grizzled as the fore part of the muzzle."

In captivity this and the other races of the species are described as being perfectly tame and good-natured, without any tendency to the petulant and mischievous habits of the smaller monkeys. In a wild state the habits of all the races are doubtless similar.

THE BLACK LEMUR

With the black lemur (*L. macaco*) we come to the first of two well-defined species, differing considerably from those already noticed; this difference being chiefly shown by the presence of a more or less well-marked ruff fringing the cheeks and chin, and frequently also by a fringe of hairs on the margins of the ears. Moreover, all these lemurs are subject to great variation in colour, which in one case appears to be merely individual, while in another it is distinctive of the two sexes.

The black lemur (pages 277, 281) comes from the north-west coast of Madagascar; and the male, on the evidence of which the species was described, is uniformly black, with a well-developed ruff round the cheeks and neck, and a long fringe to the ears. Very different, however, is the female, which was at first described under the name of the white-whiskered lemur (*L. leucomystax*). In this sex the general colour of the fur is brown, with a patch on the lower part of the back, and the ruff round the face and the fringe on the ears white.

A female of this species in the Gardens of the Zoological Society twice gave birth to a young one, and thus afforded an opportunity of seeing the curious manner in which lemurs carry their offspring. The young one born on March 24, 1884, proved to be a female, and was of the same brown colour as its mother. On April 3 in the following year the second young one was born, which was a male, and at the time of birth it was of the black hue of its father. Each was carried lying nearly across the abdomen of its mother, with its tail passed round her, and thus on to its neck, so as to form a firm attachment; and it is believed that, at least in the wild state, the young are at a later period carried on their mother's back.

THE RUFFED LEMUR

Another and the largest of the true lemurs is the ruffed lemur (*L. varius*), which inhabits the north-east coast of Madagascar (page 282). As its name implies, it is remarkable for the great individual variation in the colour of the fur; such variations being apparently independent of sex. Frequently the colour is a mixture of black and white, disposed in patches on different parts of the body, but occasionally white individuals are met with. Other individuals are of a nearly uniform reddish brown colour; this variety having been regarded as a distinct species, the red lemur (*L. ruber*).

A specimen of the red variety in the Gardens of the Zoological Society had the upper surface of the



THE GREY GENTLE LEMUR

Photograph by W. S. Berridge

body bright rufous brown, while the under parts were deep black. The reddish area included the sides of the face, ears, back, and flanks, and the outer surfaces of the limbs; while the black embraced the forehead and face, the throat, chest, and abdomen, the inner surfaces of the limbs, and the hands and feet, with the exception of a narrow stripe of white across their upper surface. On the back of the neck there was a large white patch. The length of the head and body of this animal was two feet, and that of the tail somewhat more.

Here may be briefly noticed two other members of the typical genus. The first of these is the red-bellied lemur (*L. rubriventer*), so named on account of the rufous colour of the under parts. In the female, the so-called *L. flaviventer*, the under surface is yellowish. The second species is the sooty lemur (*L. nigerrimus*), readily distinguishable from the black lemur by the much shorter ear tufts and ruffs. The skulls of both these species show characteristic features.

THE GENTLE LEMURS

The grey gentle lemur (*Haplemur griseus*), which, like all the members of the group under consideration, is an inhabitant of Madagascar, differs so decidedly from the true lemurs that it has been made the type of a distinct genus (*Haplemur*), of which it is the representative species.

It may be readily distinguished from the true lemurs by its rounded head and extremely short muzzle, the ears being likewise very short. A peculiar feature is the presence of a small bare patch on the front surface of the forearm, a little above the palm of the hand, which is covered with small spines. The colour is a dark iron grey, with a tinge of yellow, becoming somewhat paler on the under parts and the inner sides of the limbs. The individual hairs are black, with a reddish band near the tips.

The species differs from the true lemurs in being purely nocturnal in its habits. It is chiefly found in bamboo jungles, and subsists mainly on the young tender shoots of these plants, as well as on their leaves. In such jungles its capture is difficult, and

hence living examples are rare in menageries. An allied lemur living in the Zoological Society's Gardens in 1870 was described as *H. simus*, and is now known to be a perfectly distinct species, having, however, the same shiny gland-patch on the wrist as the grey gentle lemur. According to a French traveller, the last is known to the natives of Madagascar as the bokombouli.

THE WEASEL LEMUR

The slender, or weasel, lemur is the last representative of the present group, and belongs to a genus (*Lepidolemur*) containing several species which differ from all other lemur-like animals in having, when adult, either no upper front (incisor) teeth at all, or merely a single pair of minute rudimentary ones. This character will at once suffice to distinguish these animals from the gentle lemurs, which they resemble in being of purely nocturnal habits. Further points of distinction are afforded by the greater length of the muzzle and by the ears being bald and somewhat larger. The tail is long and covered with close-set short hair.

The weasel lemur (*Lepidolemur mustelinus*) is chiefly found in the north-west of Madagascar, and is characterised by having no upper front teeth at all when quite full grown. Its head and body together measure about 10 in. in length, and the tail is 14 in. long. There are two other nearly allied species of these lemurs, namely, *L. ruficaudatus* and *L. edwardsi*, both of which are smaller than the typical species, and distinguished from one another chiefly by their colouring. In the first named the general colour of the fur is pale or reddish grey, becoming brown on the head.

The weasel lemur, during its nocturnal rambles, is marvellously active, and capable of taking tremendous leaps among the trees in which it dwells; its slender build and long limbs being admirably adapted for such a mode of progression. Like the grey gentle lemur, it subsists solely on leaves; and it is much sought after as an article of food by the natives of Madagascar, to whom it is known by the name of fitili-ki. It is killed by being knocked on the head with a stick while curled up during the day in its nest of leaves, to which it has been tracked down at the end of its nocturnal excursions.

Certain other species, such as *L. microdon*, are broadly distinguished by their inferior bodily size and the much smaller molar teeth. They are rare and little-known animals, passing most of their time in sleep.

THE MOUSE LEMURS

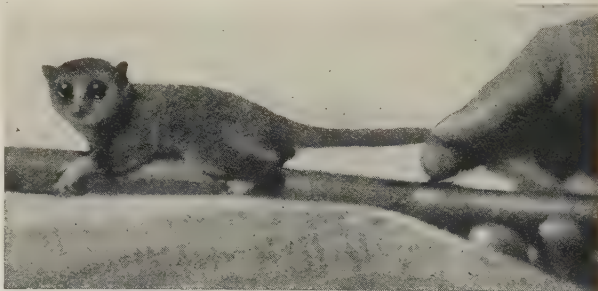
The tiny creatures known as the mouse lemurs (genus *Chiromys*) are the first of a group of two genera which differ from all other members of the lemur tribe in that the bones of the upper part of the ankle are enormously elongated, thus causing the whole foot to be much longer than in the preceding groups.

The mouse lemurs themselves are confined to Madagascar; and include the smallest of the lemurs, some being even smaller than a rat. They have

long tails and rather large ears, which are hairy at their base and cannot be folded upon themselves.

The most remarkable feature connected with the mouse lemurs is that they are in the habit of hibernating, or remaining dormant for a portion of the year. But as their quiescent season is during the hottest and driest time, the term æstivating would be more appropriate. By no means all the mouse lemurs become torpid in this fashion; and it may be fairly presumed that the species in which this habit occurs are those dwelling in the more arid regions.

To prepare for this protracted period of suspended energy, during which they maintain the heat of their bodies by the consumption of their own substance, the mouse lemurs feed so vigorously that when at length the hot season arrives they are in an extremely fat and sleek condition. Curiously enough, the great accumulation of fat is mainly restricted to the region of the base of the tail; and when they retire at the close of the rainy season, during which food is extremely abundant, their tails are swollen to a prodigious size. The wasting process which goes on during hibernation leaves them with tails shrunk to very small dimensions. In order to make themselves comfortable during



SMITH'S DWARF MOUSE LEMUR

Photograph by Lewis Medland

their long sleep, they prepare snug little nests of twigs and other substances (which, it may be noted, is the custom of dormice in similar circumstances); some of their habitations being described as marvels of neat construction. Their food is mainly of a vegetable nature; although this diet is largely supplemented by insects, and even small birds are said not to come amiss. Having large round eyes, by which they are enabled readily to distinguish even the smallest objects on the darkest nights, they are in the habit of stalking nocturnal moths and beetles when these insects have settled on the boughs of trees, and then rushing upon and seizing them with a final spring.

FORK-HEADED MOUSE LEMUR

The largest and one of the longest-known of the mouse lemurs is the species taking its name from the black streak running down the middle of the back, and dividing on the top of the head so as to form a distinct fork-like mark between the eyes (*Chiromys furcifer*). The colour of the remainder of the body is grey, with a black tip to the tail. This species is found in the forests on both the east

THE AYE-AYE

and west coasts of Madagascar, though more abundant in the latter region. It is known to the natives as the *walouvi*; and is not one of those species that hibernate.

LESSER MOUSE LEMUR

The lesser mouse lemur (*C. minor*) differs from the preceding in the absence of the dark stripe down the back. The colour is pale reddish grey, with a broad whitish streak up the middle of the face; the cheeks and under parts being also light-coloured, but the slender tail more brown. The species often described as the myoxine mouse lemur (*C. myoxinus*) appears to be very closely allied.

COQUEREL'S MOUSE LEMUR

Coquerel's mouse lemur (*C. coquereli*) is characterized by the soft woolly nature of the fur, of which the prevailing colour is greyish brown, tinged with gold (page 162). It makes well-formed nests of twigs, dead leaves, and grass, and having a diameter of some 18 in. In this nest it sleeps during the day, to prowl forth at night in search of food.

DWARF MOUSE LEMUR

The smallest member of the genus is the dwarf mouse lemur (*C. smithi*), not infrequently referred to as the Madagascar rat (page 284), because it was described by Buffon under the name of *le rat de Madagascar*. The head and body of this diminutive species do not exceed 4 in. in length, while the tail measures 6 in. The prevailing colour is pale grey; the chin and under parts being pale yellow, and

the outer surface of the ears light brown, while a white streak runs up the nose and between the eyes. The eyes themselves are surrounded by black rims, giving to the face the appearance of wearing a pair of spectacles.

The dwarf mouse lemur builds beautifully constructed nests of twigs, lined with hair, in the tops of the lofty trees where it delights to dwell. These nests somewhat resemble those of a rook both in form and size, and are used not only as diurnal resting-places, but as cradles for the young. The species is remarkable for the extreme beauty of its brilliant eyes.

THE BROWN MOUSE LEMUR

The brown mouse lemur (*C. miliu*), which is one of the hibernating species, takes its scientific name from M. Milius, a former governor of Réunion, by whom two of these creatures were sent to Paris. They were described by Frédéric Cuvier in 1821 as the *maki nain*, or small lemur. The species is some 9 in. in length, exclusive of the long tail; and it is of a greyish brown colour, with black whiskers, and white throat and under parts, the fur being silky. The specimens sent to Paris thrived for some time, and became so tame that they were allowed to leave their cages.

Many naturalists restrict the genus *Chirogaleus* to this and a few other allied species, referring those previously mentioned to another genus, *Microcebus*. Two other kinds—namely, *C. samuti* and *C. thomasi*—are regarded as indicating a third generic group, known as *Opolemur*.

THE AYE-AYE

ONE of the most remarkable of all lemuroids, and at the same time of the whole order of Primates, is the aye-aye of Madagascar, which has teeth so utterly different from all other members of the order that it was long considered to belong to the rodents (rats, rabbits, etc.). Till comparatively recent times the aye-aye was regarded as widely sundered from the typical lemurs of the family *Lemuridæ*. But it has been discovered that it possesses a similarly formed drum of the ear, while it is quite evident that its peculiar teeth are merely an adaptation to a particular kind of life. Accordingly, some naturalists have proposed to include it in the family *Lemuridæ*. But it is, on the whole, more convenient to regard it as the representative of a separate family, the *Chiromyidæ*.

The most peculiar feature about the dentition of the fully adult aye-aye (*Chiromys madagascariensis*) is that the front, or incisor, teeth are reduced to a single pair in each jaw, which are curved, and have their extremities brought to a sharp chisel-like edge, admirably adapted for gnawing and rasping hard substances. The structure of these teeth is, in fact, precisely the same as in the front teeth of rats and beavers; their sharp cutting edges being produced by the circumstance that while the body of the tooth is formed of comparatively soft ivory, the front surface is faced with a layer of hard, flinty enamel. It will be obvious that the result of wear in a tooth

of this type will be to produce a chisel-like edge. It will further be apparent that such a tooth, if continually employed in rasping away hard substances, would be very quickly worn down altogether, if it were of the same length as ordinary teeth, and not provided with some kind of renewal. This difficulty is obviated by the front teeth remaining open at their lower ends, and undergoing a continual process of growth; so that as their summits are worn away they are pushed farther up from below. In all these points the teeth are precisely similar to those of rodent mammals. A further resemblance to rodents is shown by the absence of tusks, and also by the cheek teeth being separated by a long gap from the incisors, as well as by being reduced in number, and having their crowns with nearly flat surfaces, instead of being surmounted with the sharp cusps found in those of the true lemurs. Indeed, the total number of teeth in the adult aye-aye is only eighteen, these being expressed by the formula $i.1., c.3., p.m.1., m.3.$, or exactly the same as in many rodents.

If, then, the teeth of the adult aye-aye are so exactly like those of a rodent, the reader may well ask why it is not placed among the rats and beavers, instead of among the lemurs. To this it may be replied that in the young aye-aye the milk, or baby, teeth are very much more like those of the true lemurs; while the anatomy of the skeleton and the soft parts is essentially that of a lemur, and not

that of a rodent. The resemblance of the skull and teeth to those of a rodent is, indeed, an excellent instance of what naturalists term an "adaptive" or "parallel resemblance." When two animals belonging to totally different groups have more or less nearly similar habits, it frequently results that they will closely resemble one another in at least some part of their structure, such particular structure being the one best adapted for a particular mode of life. In all such cases a superficial examination of the animals in question will frequently lead to their being referred to one and the same group; while further minute investigations will reveal the fact that their deep-seated internal structure—which alone reveals their true affinities—is very different. Such was the case with the aye-aye, which was at first referred to the rodents, its affinities to the lemurs not having been discovered till a fuller examination.

The aye-aye agrees with the true lemurs in having the great toe of the foot furnished with a flattened nail, and capable of being opposed to the other toes, this feature being alone sufficient to prove that the creature has nothing to do with the rodents. With the exception of this great toe, however, all the toes and fingers, which are very long and narrow, are furnished with narrow and sharply pointed claws. Although both the hands and the feet are large in proportion to the size of the animal, yet the great peculiarity is concentrated in the hands, in which the fingers are much longer than are the toes of the feet. One finger—namely, that corresponding to the human middle finger—is more remarkable than the others, being of great length and extreme slenderness. It is probable that this ghostly middle finger is employed in extracting from their burrows the larvæ which form a portion of the creature's natural diet.

In size the aye-aye may be compared to a cat; its total length being about 3 ft., of which the larger moiety is formed by the bushy tail. The comparison with a cat may be further extended to the short and rounded head and cat-like face of the animal. The rounded ears are, however, relatively larger than those of a cat, and have the peculiarity of being nearly naked. The fur is long and composed of a mixture of longer, stiffish hairs, with an under-coat of shorter and bushier ones. The prevailing colour is dark brown, tending to black, washed with whitish; the throat is yellowish grey, and the under parts show a rufous tinge. Some of the longer hairs on the back are whitish, producing a somewhat mottled appearance in the fur.

The aye-aye was discovered by the French traveller Pierre Sonnerat so long ago as 1780; and was described in the first year of the nineteenth century by Baron Cuvier, who regarded it as a kind of squirrel. Nothing more was heard of the creature from Sonnerat's time till 1860, when specimens were sent to England and described by Sir Richard Owen. The name is variously stated to be derived

from the aye-aye's cry, "haihay, haihay," or from the natives' exclamation of surprise, "hay! hay!" at the sight of the animal, which they also call the haikay. The Rev. G. A. Shaw gives the following interesting account of its habits:

"Being a nocturnal animal, it is very difficult to get any trustworthy information concerning its habits in the wild state, and native reports are altogether contradictory with respect to these matters. Even with reference to its natural food, no satisfactory explanation can be obtained from the people. Many assert positively that it lives on honey; but one I had in captivity would

not eat honey in any form, either strained or in the comb, or mixed with various things I thought he might have a fancy for. Others say it lives on fruits and leaves; others that birds and eggs are its natural food. I fancy, from what I saw of my captive, that both these conjectures are nearer the truth; for after a few days, during which it would eat nothing, and it was thought that the proper food had not been offered—but it was, in reality, pining or sulking—it took several fruits which I was able to procure for it. It liked bananas; but it made sorry efforts at eating them, its teeth being so placed that its mouth was clogged with the food. The small fruits of various native shrubs it also devoured, as also rice boiled in milk and sweetened with sugar; but meat, larvæ, moths, beetles, and eggs it would not touch. But I noticed that when I came near its cage with a light, it almost invariably started and went for a little distance in chase of the shadows of the pieces of bananas attached to the wirework in front of its cage; and I think that if I could have procured some small birds it would have, if not devoured them, at any rate killed them for their blood, as some lemurs are known to do. It drank water occasionally, but in such a way as to make it highly probable that it does not drink from streams or pools in the ordinary way. It did not hold its food in its hands, as the lemurs which I have had in captivity have done, but merely used its hands to steady it on the



THE AYE-AYE

bottom of the cage. But whenever it had eaten, although it did not always clean its hands, it invariably drew each of its long claws through its mouth; as though, in the natural state, these had taken a chief part in procuring its food.

"In some accounts, given by different writers, the haikay is said to be easily tamed, and to be inoffensive. . . . In each of these qualities, I have found, both from native accounts and from the specimen I have kept, that exactly the reverse is the case. It is very savage, and when attacking strikes with its hands with anything but a slow movement. As might be imagined in a nocturnal animal, its movements in the daytime are slow and uncertain; and it may be said to be inoffensive then. When it bit at the wire netting in the front of its cage, I noticed that each of the pair of incisors

in either jaw could separate sufficiently to admit the thick wire even down to the gum, the tips of the teeth then standing a considerable distance apart, leading to the supposition that, by some arrangement of the sockets of the teeth, they could be moved so far without breaking. The haikay brings forth one at a birth, in which the long claw is fully developed."

It has been observed that captive aye-ayes are very partial to the juice of the sugar-cane, which they obtain by ripping up the canes with their front teeth; and since sugar-cane grows wild in Madagascar, we may infer that its juice forms a part of the food of these animals in their wild state. It is therefore probable that the diet of the aye-aye is a mixed one, consisting partly of grubs, partly of the juices of plants and partly of fruit.

GALAGOS AND LORISES

THE lemur-like African animals known as galagos, together with the lorises of South-Western Asia and the pottos of Equatorial Africa, were formerly included in the same family as the lemurs, but since they differ from all the latter in the structure of the drum of the ear, they are now assigned a family by themselves (*Lorisidæ*), of which the galagos form one section, or subfamily, the *Galaginæ*, and the lorises and pottos a second, *Lorisinæ*.

THE GALAGOS

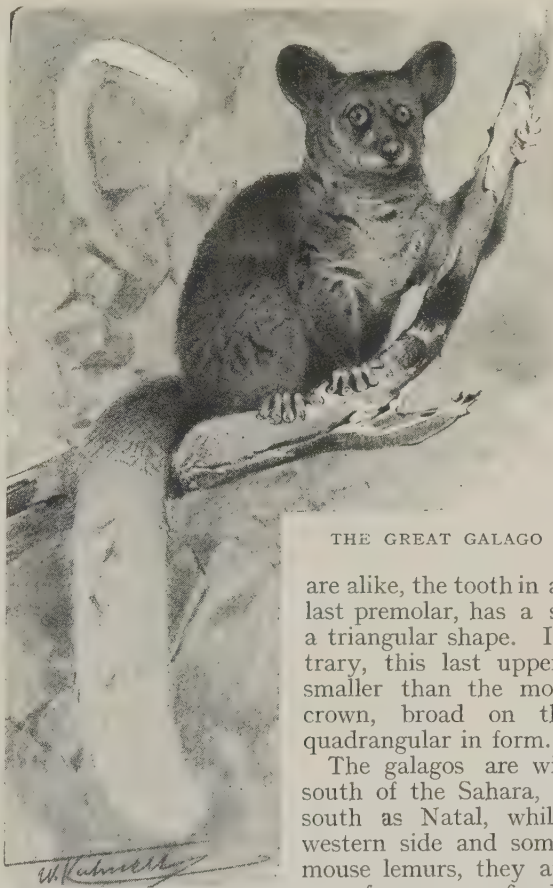
The galagos are the only long-tailed lemurs found throughout the greater part of Africa. The name is said to be that by which one of the species is known to the natives of Senegal. They resemble the mouse lemurs in having the bones of the upper half of the ankle greatly elongated, and thus have the same lengthy foot; but this structure has apparently been developed quite independently in the two groups. Although some are much bigger, there are others quite as small as, the smaller mouse lemurs. There is, however, a readily recognised external character by which a galago can be at once distinguished from a mouse lemur. This consists in the large size of the ears, which are quite bare, and have the unique peculiarity that they can be partially folded upon themselves at such

times as their owners please, so as to lie nearly flat upon the sides of the head. This may be for the purpose of protecting these delicate organs when passing through thick foliage, especially if wet.

This distinctive peculiarity of the ears is, of course, sufficient to separate a galago from a mouse lemur, and, indeed, from every other kind of lemur. Naturalists are, however, by no means satisfied with distinguishing animals merely by external characters; and they have discovered a feature in the teeth by which a galago differs markedly from a mouse lemur, although, unfortunately, this point of distinction can only be seen in a dried skull. If, however, we take the skull of a mouse lemur we shall find that while the last three upper teeth, or molars, have broad crowns and

are alike, the tooth in advance of these, which is the last premolar, has a smaller and simpler crown, of a triangular shape. In a galago's skull, on the contrary, this last upper premolar, although slightly smaller than the molars, has a similarly shaped crown, broad on the inner side, and nearly quadrangular in form.

The galagos are widely distributed over Africa south of the Sahara, one kind being found so far south as Natal, while there are several on the western side and some on the eastern. Like the mouse lemurs, they are essentially nocturnal, and are, of course, confined to those regions where thick forest prevails. When not enjoying their diurnal repose, they are lively and interesting. They subsist on a mixed diet, including fruits, insects, and small birds and their eggs. Some of the smaller species



THE GREAT GALAGO

will readily devour locusts and the peculiar leaf-like mantides, or praying insects. When on the ground, the galagos recall the lemurs of the indri group, in that they generally sit in the upright position, and progress by a series of leaps or hops. They usually have two or three young at a birth, and are stated to have bred in captivity in Africa, although we are not aware that they have done so in Europe. Many of them, however, thrive well in menageries, where some have been represented by a considerable number of individuals. It is stated that the galagos resemble the mouse lemurs in building nests, which are situated in the forked branches of trees; but it is probable that this is only true of the smaller species. They appear, however, to be peculiar in that several individuals will inhabit the same nest, out of which they all rush when suddenly disturbed. Galagos frequently stand upright in a characteristic attitude, with their arms extended horizontally outwards. The total number of teeth, both in the galagos and the mouse lemurs, is the same as in the true lemurs.

THE GREAT GALAGO

With the exception of a closely allied kind from the West Coast, the great, or thick-tailed, galago (*Galago crassicaudata*) of Mozambique and the Lower Zambezi valley is the largest of all the species. In size it is about equal to a cat of average dimensions, and, indeed, the peculiar manner in which it carries its thick bushy tail high above its back is highly suggestive of a pampered Persian cat. This bushy tail is about one-fourth longer than the head and body. The great galago belongs to a group of several species, in which the ears are unusually long, and the muzzle is considerably elongated, while the feet are comparatively broad and short, and the fingers and toes have broad disc-like expansions at their extremities. The colour of the fur is a uniform dark brown (page 287).

Writing of this species, Sir John Kirk observes that "it is confined to the maritime region, so far as I know never penetrating beyond the band of wood generally known as the mangrove forests. By the Portuguese it is named 'rat of the coco-nut palm,' that being its favourite haunt by day, nestling among the fronds; but if it be disturbed, performing feats of agility, and darting from one palm to another. It will spring with great rapidity, adhering to any object as if it were a lump of wet clay. It has one failing, otherwise its capture would be no easy task. Should a pot of palm-wine be left on the tree, the creature drinks to excess, comes

down, and rushes about intoxicated. In captivity they are mild; during the day remaining either rolled up in a ball, or perched half asleep, with ears stowed away, like a beetle's wing under its hard and ornamented case. I had half a dozen squirrels with one in the same cage; these were good friends, the former creeping under the galago's soft fur and falling asleep. On introducing a few specimens of [elephant] shrew, the galago seized one and bit off its tail, which, however, it did not eat. The food it took was biscuit, rice, orange, banana, guava, and a little cooked meat. Stupid during the day, it became active at night, or just after darkness set in. The rapidity and length of its leaps, which were absolutely noiseless, must give great facilities to its capturing live prey. I never knew it give a loud call, but it would often make a low, chattering noise. It has been observed at the Luabo mouth of the Zambezi, at Quilimane, and at Mozambique. When I had my live specimen at Zanzibar, the natives did not seem to recognise it; nevertheless, it may be abundant on the mainland."

On the West Coast of Africa, in Angola, the great galago is represented by the closely allied



GARNETT'S GALAGO
From the "Proceedings" of the Zoological Society

Monteiro's galago (*G. monteiroi*), which is of slightly larger size than the East Coast species; the length of the head and body being 12 in., and that of the tail 16 in. Although these two galagos differ mainly or entirely by their coloration, yet, according to Sir John Kirk, the eastern species is confined to the coast region, and it is probable that there is a wide area separating the habitats of the two, which suggests the advisability of regarding them as distinct species. As a rule, Monteiro's galago is of a uniform pale grey colour, with the sides of the nose somewhat darker, and the throat and tail nearly or quite white. The fur is soft, with the component hairs slate-coloured at their roots and white at the tips.

GARNETT'S GALAGO

Garnett's, or, as it is sometimes rather inappropriately called, the black galago (*G. garnetti*) is a species belonging to the same group as the preceding, from which it differs in its inferior size. It is an inhabitant of Eastern Africa, and is of a dark brown colour, tending to yellowish on the under parts, with black ears, and a white streak on each side of the loins. One of these animals, formerly in the Zoological Society's Gardens, when let loose one night in the apartments of the superintendent, exhibited to perfection the leaping habits and

THE GALAGOS

extreme agility characteristic of its tribe. It leaped after the manner of a kangaroo, clearing several feet at a spring, and hopping on to the table and other articles of furniture in the room. Strange to say, it exhibited no signs of fear of the dogs and cats with which it was confronted.

ALLEN'S GALAGO

With the West African species we come to the first representative of a group distinguished from the preceding one by the more rounded head, shorter muzzle, and larger eyes, as well by the longer and more slender form of the foot.

Allen's galago (*G. alleni*) is found at Fernando Po and the Gabun, and is characterised by the tail being thick and bushy, and also by the extreme length and slenderness of its fingers and toes. The prevailing colour of the fur is greyish brown, with the forehead, rump, and the root of the tail grey, a tinge of red is on the limbs, the tail is black, and a streak on the nose and all the under parts are whitish. If we examine the skull, it will be noticed that the last molar tooth on each side of the upper jaw is nearly equal in size to the tooth in advance of it. This will be found an important point of distinction between Allen's galago and all the remaining species, in which the last upper molar is much smaller than the tooth in front of it.

The pale-coloured galago (*G. pallida*) of Western Equatorial Africa seems to be only a colour-phase of the present species, and not a distinct form. It was met with by Du Chaillu, who believed that he had discovered a new species. The general colour is grey, and the tail unusually long.

THE SENEGAL GALAGO

The longest known of all the group is the Senegal galago (*G. senegalensis*), originally described in 1796 from specimens brought from Senegambia, which may be regarded as its headquarters. Subsequent discoveries have, however, shown that a galago exists on the east side of Africa to the south of the Sudan, which, although described as a distinct species under the name of the Senar galago (*G. senariensis*), is so closely allied to the Senegal galago that it may probably be regarded as a mere local variety or race. Indeed, it is likely that when we are fully acquainted with the zoology of the vast stretch of country lying to the south of the Sahara Desert, it will be found that this galago extends right across Africa.

In addition to the distinctive character of the upper molar teeth already mentioned, the Senegal species has certain marked external features by which it differs from Allen's galago. Thus, in the tail the

hairs near the root are pressed down, only those nearer the end spreading out on all sides, so that the whole tail assumes a somewhat club-like form. Then, again, the fingers and toes are considerably thicker and shorter than in Allen's galago. In colour the typical Senegal galago is grey, with the under parts and a streak on the nose white, and the tail, hands, and feet blackish brown. The Senar race appears to have a rather bluer tinge to the fur, with a darker face, and black rings round the eyes; while the tail is described as being relatively longer. It is of comparatively small size, and appears to be common in the forests of Senegal, and in those on the Blue Nile in Kordofan, and the White Nile in Senar. Its chief food consists of various kinds of insects; but it is stated that it will also eat the gum of several sorts of acacia, which also form part of the diet of the baboons of the Sudan. Its habits are said to be similar to those of the other species.

In South Africa the Senegal galago is represented by a form so nearly allied that many naturalists regard the two as only local races of a single species. This southern form is the Moholi galago (*G. senegalensis moholi*), which is an inland race found as far south as Natal, and also met with in Nyasaland and the adjacent districts. A galago from the neighbourhood of Titi, some distance up the Zambezi, has been identified with the Senar race of the Senegal galago, but it would appear probable that it is the southern form. The prevailing colour is brownish, or yellowish grey, becoming darker on the back,

and still more so on the tail; while a broad streak on the nose, the cheeks, and the throat are white, and the inner surfaces of the limbs and the under parts are whitish with a faint tinge of yellow. In a male specimen sent to England by Sir Andrew Smith—the original describer of this animal—the fur surrounding the eyes is of the same colour as that on the other parts of the head. In other examples, however, there are dark rings round the eyes. This variability shows that the presence or absence of such rings cannot be regarded as indicating a specific distinction between the Senegal and Senar galagos.



MOHOLI GALAGO
Photograph by W. S. Berridge

DEMIDOFF'S GALAGO

The smallest member of this group of the present genus is Demidoff's galago (*G. demidoffi*), from the West Coast of Africa, which differs from both the two species that have just been considered in its much more slender and more cylindrical tail and smaller ears. The length of the head and body is 5 in., and that of the tail, $7\frac{1}{2}$ in. The

general colour of the soft fur is brown, darker on the sides of the face; the white streak on the nose being narrow; and the chin, throat, and under parts of a reddish grey colour. The so-called *G. murinus*, from Old Calabar, is probably not specifically separable from this galago.

SLOW LORISES

With the lorises of the warmer parts of Asia (genus *Nycticebus*) we come to the second section of the *Lorisidae* family; this group also including the pottos of Africa. The members of this group may be recognised either by the total absence of the tail, or by its length not exceeding one-third that of the head and body. The only lemur with which these animals could possibly be confounded would therefore be the indri of Madagascar; but, irrespective of its larger size, the latter is at once distinguished by the web uniting the bases of the toes, and the full development of the index finger of the hand. Moreover, the slow lemurs and the pottos may be further distinguished, not only from the indri, but likewise from all other lemurs, by the index finger of the hand being invariably very small, and even rudimentary, and without any trace of a nail. Then, again, all the lorises and pottos are peculiar in having the thumb of the hand and the great toe of the foot very widely separated from the other digits; this divergence being carried to such an extent in the case of the great toe that it is actually directed backwards instead of forwards.

Apart, therefore, from their distribution, there is no difficulty in distinguishing a loris or a potto from a lemur. All the members of the present group have the same number of teeth as the true lemurs, but they differ from galagos in that the bones of the upper part of the ankle are of ordinary proportions, so that the foot is not abnormally lengthened.

The lorises are purely nocturnal, and are well known for the extreme slowness and deliberation of their movements, the latter characteristic having given their distinctive name to the Asiatic representatives of the group. It was probably their deliberate motions, nocturnal habits, and large glaring eyes, that suggested to Linnæus the name of "lemur" for the group generally.

Lorises are distinguished from pottos by having a well-developed but small index finger on the hand, which has the usual three joints, and is provided with a distinct nail. They have no external tail, and are, as already mentioned, strictly confined to

the tropical and subtropical regions of Asia. There are two distinct types of lorises, which are very closely allied, although most naturalists consider it advisable to divide them into two genera. It has been stated that there is a long-tailed slow loris in the Lushai hills of North-Eastern India, but this requires confirmation.

The slow lorises (page 163) have been regarded as referable to a single variable species, *Nycticebus tardigradus*, but, according to Mr. M. W. Lyon, they are divisible into two distinct groups, in one of which a sagittal crest is developed on the skull of the adult, while in the other no such ridge occurs. The second group occurs only in Borneo and Banka, and appears

to be further characterised by having only one pair of upper incisor teeth, in place of the two pairs found in the first.

The distinctive features of the slow loris, as the representative of a genus, are that the eyes are not of very enormous size, and are separated from one another by a considerable space; while the general build of the animal — more especially as regards its limbs—is comparatively stout.

The name loris, by which all these lemuroids are commonly designated, is derived from the Dutch word *loeris*, meaning a clown, and appears to have been applied to these



THE SLOW LORIS

Photograph by W. S. Berridge

animals by the Dutch colonists of the East Indian Islands. To the natives of India the slow loris is known either by the name *sharmindi billi*, "bashful cat," or *lajjar banar*, "bashful monkey." It is an animal about the size of a cat; different individuals or races varying considerably in size, so that while some specimens do not measure more than 13 in. in total length, others may reach as much as 15 in., or even more. Its proportions are thick and clumsy, the head being broad and flat, with a slightly projecting and pointed muzzle. The large eyes are perfectly circular, and their pupils can be completely closed by the gradual contraction of the iris, which opens from above and below, so that when the pupil is half concealed it takes the form of a transverse slit. The ears are short, rounded, and partly buried in the fur, and are thus very different from those of the galagos. The hind limbs are only slightly longer than the front pair. With the exception of the muzzle and the hands and feet, the whole of the body is covered with a thick coat of very close and somewhat long woolly fur.

There is a considerable amount of variation in the colour of different local races of the ordinary slow loris, although in all cases there is a dark stripe running down the middle of the back, sometimes

THE LORISES

extending on to the head. In the more common and larger variety, the colour of the fur is ashy grey above, tending to become silvery along the sides of the back, the under parts being lighter, and the rump often having a tinge of red. The stripe on the back is chestnut-coloured, and stops short at the hind part of the crown of the head. The eyes, however, are surrounded by dark rims, between which is the white streak extending upwards from the nose. The ears, together with a small surrounding area, are brown.

In another and generally smaller variety the hue of the upper parts has a distinct tinge of red mingling with the grey, while the stripe on the back is wider, and often of a full brown colour; but, instead of stopping short at the back of the crown of the head, this band widens out into a large brown patch on the crown, which embraces the ears. The eyes, however, although surrounded by brown rings, are not connected with the patch on the head by a dark-coloured area. There is yet a third variety of this creature, found in Tenasserim, in which the general colour is pale rufescent, while the dark stripe on the back, instead of expanding on the crown of the head, merely splits into a fork, of which each prong joins the dark ring round the eyes.

Slow lorises are found over a large area in the countries lying to the east of the Bay of Bengal. They occur on the north-eastern frontier of India in the provinces of Sylhet and Assam, whence they extend southwards into Burma, Tenasserim, and the Malay Peninsula; while they are also found in Siam and Cochin China, and the islands of Sumatra, Java, and Borneo.

The food of lorises consists of leaves and young shoots of trees, as well as fruits, various kinds of insects, birds, and their eggs. Lorises have been observed to stand nearly erect upon their feet, and from this advantageous position pounce on insects. They are generally silent, although sometimes uttering a low crackling sound; but when enraged, and especially if about to bite, they give a kind of fierce growl. The slow loris is tolerably common in the Tenasserim provinces and Arakan; but, being strictly nocturnal in its habits, is seldom seen. It

inhabits the densest forests, and never by choice leaves the trees. Its movements are slow, but it climbs readily, and grasps with great tenacity. If placed on the ground, it can proceed, if frightened, in a wavering kind of trot, the limbs placed at right angles. It sleeps rolled up in a ball, its head and hands buried between its thighs, and wakes up at the dusk of evening to begin its nocturnal rambles. The female bears only one young at a time. Many accounts have been published of the habits of the slow loris in confinement. All observers are agreed that, while these creatures are apt to be fierce when

first captured, they soon become docile. They are very susceptible to cold, and, when so affected, are apt to be fractious and petulant.

The Javan slow loris (*N. tardigradus javanicus*), said to be confined to the island from which it derives its name, is distinguished by having four brown bands down the head and face from the crown, one band going to each eye, and one to each ear; the interspaces being pale and the space between the eyes white. As this type of colouring is only one step in advance on that obtaining in the third variety of the slow loris, it is evident that the Javan loris has no right to rank as a separate species.

SLENDER LORIS

The slender loris (*Loris gracilis*) is the sole species of the genus to which it belongs. It is distinguished from the slow loris by its lighter build of body and longer and more slender limbs, as well as by the greater size of the eyes, which are separated merely by a narrow space.

The ears are also somewhat larger than in the slow loris.

The slender loris is a much smaller animal than the slow loris, the length of the head and body being about 8 in. In colour it is a dark earthy grey, with a more or less marked ruddy tinge on the back and outer sides of the limbs, and showing a faint silvery wash, the under parts being much paler. Between the eyes there is the usual narrow white stripe, which spreads out on the forehead; and the cheeks and region round the eyes are darker than the rest of the body. Some young specimens are decidedly reddish.

This animal is confined to the forests of Southern India and Ceylon, and appears only to be found in



THE SLENDER LORIS



SLENDER LORIS CLIMBING
Photograph by W. S. Berridge

those which are situated at a comparatively slight elevation above the sea-level. This Ceylon race is distinguished by its redder colour from the Indian one, in which the general hue is greyish. The habits of the slender loris are very similar to those of its cousin the slow loris, although its movements are not quite so deliberate. It partakes of similar food, and sleeps rolled up like a ball, with its head between its thighs, and its hand grasping the bough on which it is seated.

I once had occasion to purchase a pair of these animals in the bazaar at Madras, and was surprised to find the number of specimens which were exposed for sale. On the voyage up to Calcutta these pretty little creatures lived mainly on a diet of plantains and rice, supplemented with an occasional cockroach; but as they passed the whole day in slumber, they could scarcely be reckoned as very lively pets.

Sir J. Emerson Tennent, who states that this loris has acquired the name of the "Ceylon sloth" in Ceylon, observes that its singularly large and intense eyes have attracted the attention of the Sinhalese, "who capture the creature for the purpose of extracting them as charms and love-potions, and this they are said to effect by holding the little animal to the fire till the eyeballs burst. Its Tamil name is *thavangu*, or 'thin-bodied'; and hence a deformed child or emaciated person has acquired in the Tamil districts the same epithet. The light-coloured variety of the loris in Ceylon has a spot on the forehead, somewhat resembling the *namam*, or mark worn by the worshippers of Vishnu; and from this peculiarity it is distinguished as the *nama thavangu*."

THE POTTOS

In Equatorial Africa the place of the lorises of Asia is taken by certain peculiar species which may be collectively known as pottos, although in its proper application the native name *potto* appears to be

restricted to the first of the two groups. The pottos are distinguished by the index finger of the hand being quite rudimentary, consisting only of a stump without distinct joints, and unprovided with a nail. The typical pottos are further distinguished by possessing a short tail, but since this appendage is rudimentary in the allied group of *awantibos*, it does not afford any characters by which the African group can be distinguished from their Asiatic relatives. The habits of pottos are very similar to those of lorises, but their movements are still more deliberate and more sluggish.

The typical Bosman's potto (*Perodicticus potto*) takes its name from having been discovered by the Dutch navigator Van Bosman, who met with it on the coast of Guinea, and described it in 1705 under its native name of *potto*.

It is an animal of somewhat robust build, chiefly characterised by having a tail of about one-third the length of the head and body, the whole body being covered with a thick coat of soft and moderately long hair. The small and rounded ears stand up well above the fur of the head, the large eyes are separated from one another by a considerable interval, and the muzzle is rather broad and not very long. The arms and legs are of nearly equal length. With the exception of the nearly naked nose and chin, which are flesh-coloured, the general colour of the animal is a kind of chestnut, with a black or greyish tinge, the throat and under parts being yellowish brown. The peculiar half-red half-grey tint of the fur on the back is produced by the hairs being slate-coloured at their roots, reddish in the middle, and paler at the tips.

In addition to the loss of the index finger of the hand, the potto presents a curious peculiarity connected with the joints of the backbone in the neck. The spines of these vertebræ, which rise from the upper surface, are so elongated that they actually project beyond the general level of the skin of the back of the neck, where they form a series of little



BOSMAN'S POTTO
Photograph by W. S. Berridge

THE TARSIER

humps. We are at present unacquainted with the object of this peculiar structural arrangement.

Like lorises, pottos are nocturnal in their habits, sleeping during the whole of the day rolled up in a ball, with the head between the fore legs, and folded into the chest, and supporting themselves in captivity by grasping the bars of the cage with both hands and feet.

Bosman's potto is found over a considerable extent of the West Coast of Africa, having been recorded from Guinea, Sierra Leone, and the Gabun. Unfortunately, however, we have but few details as to its habits in a wild state, this being probably largely due to the creature having been seldom seen by Europeans. A larger species (*P. edwardsi*) inhabits the Gabun district, while a third kind (*P. batesi*) is recorded from the Congo. A fourth species (*P. ibeanus*) is a native of Uganda.

THE AWANTIBOS

The awantibo, or Calabar potto (*Arctocebus calabar-ensis*), was long believed to be a much rarer animal than Bosman's, but of late years numerous skins have been brought to Europe. It inhabits the regions around the Old Calabar River, flowing into the Bight of Biafra, east of the Niger. The awantibo is distinguished from the potto, not only by its smaller size and more slender build, but also by the tail being reduced to a mere rudiment and by a still further reduction of the index finger, which is represented merely by a little tubercle on the edge of the hand. Moreover, the other fingers of the hand, as well as the toes of the foot, with the exception of the great toe, have their first joints connected by folds of skin. The entire hands and feet are relatively smaller than in Bosman's potto. In the awantibo the spines of the vertebræ do not project through the skin of the neck.

The colour of the typical Calabar awantibo is yellowish brown above, but paler on the under parts, becoming whitish in places; and the whole length of the body is just over 10 inches.

This animal has only been known to Europeans



THE AWANTIBO

since 1859, when a specimen in spirit was sent home by the Rev. A. Robb, a missionary at Old Calabar, who was unable to obtain any particulars regarding its habits, beyond the fact that it was nocturnal and lived in trees. The first living specimen to reach England arrived at the London Zoological Gardens in 1905.

A second species, the golden awantibo (*A. aureus*), from the Congo, was described in 1902. It has been already mentioned that in both pottos and awantibos the hands and feet are divided into two distinct moieties by the separation of the thumb and great toe from the other digits; this being most marked in the hand by the loss of the index finger. The hands and feet may accordingly be compared to the feet of a parrot, the structure in both cases being a special adaptation for long-continued grasping without change of position.

THE TARSIER

THE strange tarsier, although sufficiently nearly related to the lemurs to be included in the same great group, yet differs so markedly as to make it necessary to refer it to a distinct family, the *Tarsiidae*, its own name being *Tarsius spectrum* (page 164).

This animal takes its first name from the elongation of the bones of the upper part of the ankle (*tarsus*), after the manner noticed in the mouse lemurs (page 284) and galagos (page 287), and its second from its spectre-like appearance. It is a native of various islands in the Malay region, being found, in Celebes, Sumatra, Borneo, the Philippines, and some others. It has never, I believe, been exhibited alive in Europe, and since accounts at first hand from those who have seen animals in their native countries are always valuable, I may quote the description of Dr. F. H. H. Guillemard, who received

a living specimen while at Celebes and, in his "Cruise of the Marchesa," wrote as follows: "The most interesting addition to our menagerie was a tiny lemuroid animal (*Tarsius spectrum*), brought to us by a native, by whom it was said to have been caught upon the mainland. These little creatures, which are of arboreal and nocturnal habits, are about the size of a small rat, and are covered with remarkably thick fur, which is very soft. The tail is long, and covered with hair at the root and tip, while the middle portion of it is nearly bare. The eyes are enormous, and, indeed, seem, together with the equally large ears, to constitute the greater part of the face, for the jaw and nose are very small, and the latter is set on, like that of a pug-dog, almost at a right angle. The hind limb at once attracts attention from the great length of the

tarsal [ankle] bones, and the hand is equally noticeable for its length, the curious claws with which it is provided, and the extraordinary disc-shaped palps on the palmar surface of the fingers, which probably enable the animal to retain its hold in almost any position. This weird-looking creature we were unable to keep long in captivity, for we could not get it to eat the cockroaches which were almost the only food with which we could supply it. It remained still by day in its darkened cage, but at night, especially if disturbed, it would spring vertically upwards in an odd mechanical manner, not unlike the hopping of a flea. On the third day it found a grave in a pickle-bottle."

If it be added that the general colour of the fur is usually some shade of brownish fawn, with the face and forehead reddish, and a dark ring round the enormous eyes, the above account gives a very good idea of the general appearance of the tarsier, the length of the body being about 6 in. This account does not show us, however, why this animal should be separated from the typical lemurs as the representative of a separate family; and we must therefore proceed to the consideration of this point.

Now, the elongation of the bones of the upper half of the ankle evidently allies the tarsier to the galagos and mouse lemurs; and, if the other characters of the animal approximated to them, there would be no reason why it should not be included in the family. It happens, however, that there are very important differences connected with the teeth, and naturalists largely rely on these in assigning the tarsier to a distinct family.

In describing the teeth of the lemurs (page 277), it was seen that the middle pair of incisors in the upper jaw are separated from one another by an intervening space, and it may be added that they are of small size. If, however, we examine the skull of a tarsier, we shall find that these central upper incisors are of large size, and placed quite close to one another. Then, again, we shall find that the upper tusk is much smaller than in the typical lemurs. Moreover, if we examine the lower jaw, it will be seen that the tusk is formed by the canine tooth, instead of being the most anterior of the premolars; the latter tooth being smaller than either of the two premolars, instead of taking the form and function of a tusk, as in the true lemurs. In having only one pair of lower incisors, the tarsier agrees with the indri; but, in the presence of three premolars on both sides of each jaw, it resembles the true lemurs. Its whole series of teeth are thirty-four in number—four more than in the indri, and two less than in the true lemurs, and may be expressed by the formula $i.\frac{2}{1}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{3}{3}$.

It is therefore clear that the tarsier differs very markedly from ordinary lemurs, being in this respect what naturalists term a more generalised form than the true lemurs. It approximates, indeed, in this particular, very closely to certain extinct lemuroids, referred to on page 295; the teeth of the fossil genus *Microchærus* having the same formula as the one denoting those of the tarsier. It may accordingly be concluded that this animal shows in its teeth signs of affinity with the extinct European lemuroids, which have been lost in the true lemurs and their allies. In regard to the elongation of the upper half of the ankle, the tarsier is, however, evidently a specialised, or highly modified, creature; and it is probable that the same structural peculiarity did not exist in the Eocene lemuroids.

Another peculiarity of the tarsier is that the two bones of the lower portion of the leg—the tibia and fibula—instead of being quite separate from one another, as in all other lemuroids, are united in their lower half. Then, again, in place of only the toe next the great toe being furnished with a sharp, compressed claw, and all the other toes having flat nails, the middle toe is also provided with a similar compressed and pointed claw.

Reference might also be made to certain features connected with the structure of the skull of the tarsier, and likewise to some peculiarities in the anatomy of its soft parts; but enough has been said to show what a very remarkable creature it is when properly studied, and to indicate why it is referred to a distinct family.

It is, indeed, generalised, or little modified, in regard to its teeth, but highly specialised, or much modified, in respect of the bony skeleton of its legs and feet.

Professor A. A. W. Hubrecht, who has devoted much attention to the embryological development of the tarsier, is of opinion that its separation as a distinct family does not sufficiently express the peculiarities of this wonderful creature, which he regards as the most primitive phase of the Primates, sundered very widely from all the lemuroids, with which it is commonly classed. Dr. Hubrecht even goes so far as to suggest that it is illogical to place the tarsier in the same ordinal group as the lorises, and that it ought to represent an order by itself.

Dr. Guillemard directs special attention to the peculiar leaps made by his captive tarsier; and this habit of leaping is highly characteristic of the species—as it is of the galagos and mouse lemurs, in which the anklebones are modified in the same manner, although to a less degree. The tarsier is described as progressing in the woods by a series of leaps from bough to bough or along a single bough; and it



GROUP OF TARSIER

EXTINCT LEMUROIDS

doubtless makes use of similar leaps to pounce upon its living prey. In holding on to the boughs of trees, it is much aided by the sucker-like discs forming the extremities of its fingers and toes, alluded to by Dr. Guillemard. Its food consists chiefly of insects and small reptiles, and it does not appear that it ever touches fruits. Tarsiers are rare in their native land, and, instead of going in small parties, are found singly or in pairs. They are looked upon with great dread and horror by the inhabitants of the Malay Islands. According to Mr. Cumming, who once had a fentale

and young tarsier alive, the animal is known to the natives of these islands by the name of the malmag. He also states that only one young is produced at a birth; and that when the natives capture one of a pair they are sure of securing its fellow. When feeding, the tarsier sits up on its hind quarters and holds its foods in its hands, somewhat after the fashion of a squirrel.

The tarsier of the Philippines, mainly owing to slight difference in colouring, has been ranked as a distinct species, under the name of *Tarsius fuscus*.

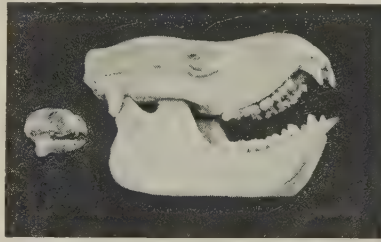
EXTINCT LEMUROIDS

ALTHOUGH remains of lemuroids had been known for very many years from the Lower Tertiary rocks both of Hampshire and France, it was long before they were definitely recognised as such, having been at first regarded as belonging to small hoofed mammals. One of these groups of lemuroids, represented by several species of different, though relatively small, dimensions, occurring both in England and France, has been described under the name of *Microchærus*; the term meaning "small pig," and having been applied from the supposed affinity of the creature to the hoofed mammals. In France very similar remains have been described under the name of *Necrolemur*. These animals were undoubtedly lemuroids, evidently allied to living forms, their skulls being very like those of the galagos, though their upper premolar teeth more nearly resemble those of the mouse lemurs. Like all early fossil lemuroids, however, they are distinguished from living forms by the circumstance that the place and form of the lower tusk are not taken by the first of the lower premolar teeth. This is very important, since it shows that these ancient lemuroids were less specialised than their living relations, and also removes any difficulty as to the descent of monkeys (in which the lower tusk always remains) from lemuroids.

Another and larger European Tertiary lemuroid, known as the *adapis*, carries the series one step still farther back, since it has four premolar teeth on both sides of each jaw, whereas no living lemur has more than three of these teeth. Here, then, we have decisive evidence of the approximation of the extinct lemuroids to the inferior orders of mammals, among which four premolar teeth frequently occur. These early Tertiary European lemuroids represent a distinct family group, the *Adapidæ*.

Madagascar has yielded a wonderful series of remains of extinct lemurs, some of which belong to genera still existing, while others indicate totally distinct and, in certain instances, gigantic types. The exploration was carried out under the auspices of the Malagasy Academy, and directed by Dr. Herbert F. Standing. In addition to those of lemuroids, bones of hippopotamuses and crocodiles were met with, as well as a carved hippopotamus tooth and a piece of Chinese pottery. The lemuroid

remains consisted of between fifty and sixty skulls and a large quantity of limb bones, but no complete skeletons. Besides remains of gigantic species allied to the existing sifakas and indris, but generically distinct, these Malagasy relics have furnished skulls and bones of a large ape-like lemuroid known as *Archæolemur edwardsi*. This and an allied species retain the primitive primate dentition, although there is a reduction in the upper molars. The lower jaw is massive, and shows many monkey-like characters, although in the adult dentition the canine has disappeared, and the anterior premolar, as in existing lemurs, has undertaken the function of that tooth. The upper incisors are large and functionally important, but the lower ones incline forwards much in the same fashion as those of modern lemurs. The dental formula is $i.\frac{2}{2}, c.\frac{1}{1}, p.m.\frac{3}{3}, m.\frac{3}{3}$. This genus retains many features of the higher Primates, which have become lost in the modern sifakas and lemurs.



SKULLS OF THE GIANT LEMUR AND A MODERN LEMUR (TO THE LEFT)

On account of their gigantic size, special interest attaches to the three species of the genus *Megaladapis*, of which *M. grandidiieri* has a skull measuring more than a foot long, so that it must have been a creature as large as a big leopard. In all three species the skull is long, low, and narrow, with a marked constriction behind the sockets of the eyes. The brain shows few convolutions in part, while behind the cerebellum was not covered by the brain itself; both features indicating degeneration. The dental formula is the same as in modern lemurs, and the genus evidently belongs to the subfamily *Lemuridæ*. The large upper molars are, however, peculiar in having tritubercular crowns, although there is some approximation to this structure in two of the existing genera of lemurs.

Dr. Standing, who does not believe in any close connection between *Microchærus* and *Adapis*, on the one hand, and modern lemurs, on the other, is of opinion that *Archæolemur* shows signs of affinity with the New World monkeys, and suggests that all the modern lemuroids, with the possible exception of the tarsier, are survivors from an original primate stock which inhabited a great land mass connecting at an earlier period of the earth's history South America, Madagascar, and a part at least of South Africa and India.

R. LYDEKKER

FLYING FOXES ON THE WING AND AT REST



FRUIT BATS, OR FLYING FOXES, ARE THE LARGEST MEMBERS OF THE ORDER

ORDER II. THE BATS

GENERAL SKETCH OF THEIR CHARACTERISTICS

By R. LYDEKKER

IN some cases there is more or less difficulty, especially when extinct types are taken into consideration, in finding well-marked characteristics by which the various orders of mammals can be distinguished from each other. With bats, however, there is no such trouble, since they are sharply separated from all other mammals by possessing the power of true flight, for the purpose of which their fore limbs are specially modified. We say true flight advisedly, for the reason that there is a kind of spurious flight possessed by certain other mammals, such as cobegos, flying squirrels, and flying phalangers, which is quite different from the flight of bats, and does not entail any special modification of the structure of the fore limbs. True flight, like that of birds and bats, is effected by means of alternate upward and downward strokes of the wings, and can be carried on so long as the muscular power of the flyer permits. Spurious flight, like that of the flying squirrels, is, on the other hand, nothing more than a prolongation of an upward or downward leap, by the aid of parachute-like expansions of the skin of the sides of the body, and cannot be extended in an upward direction beyond the limits of the impetus of the original leap.

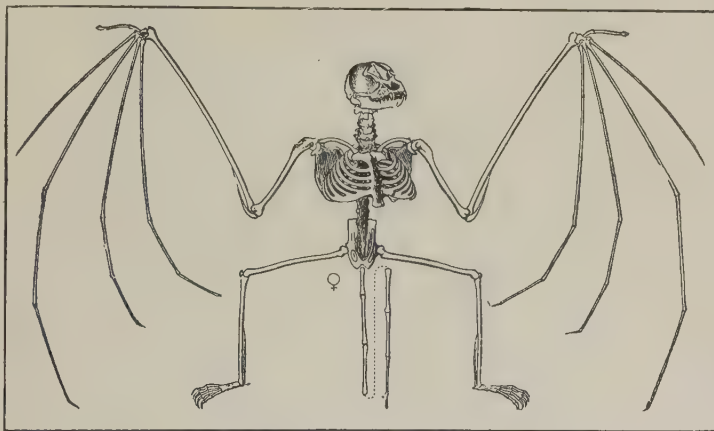
This power of true flight is, then, the essential characteristic of all bats; and it is very remarkable that among the host of extinct animals with which we are acquainted, none has been discovered in any way connecting bats with other mammals.

Indeed, remains of bats very closely resembling existing kinds are met with in the upper part of the Eocene period, showing that the order is a very ancient one, and that we should have to go back still earlier before creatures intermediate between bats and other mammals were met with. In spite of this, however, naturalists have no hesitation in believing that bats have taken origin from mammals of ordinary terrestrial habits. It is found, indeed, that in their essential structure bats are so closely allied to the Insectivora, such as shrews, moles, etc., that there can be little doubt of their derivation from the ancestral forms of that order; and it is probable that the power of true flight was developed gradually from spurious flight, like that of flying squirrels. Moreover, there is a very curious animal among the Insectivora—the cobego, or flying lemur—which is endowed with the power of spurious flight, and may thus afford some inkling of the manner in which bats have been derived from the earlier members of that order. Bats are accordingly regarded by naturalists as neither more nor less than Insectivora

specially modified and adapted for an aerial life. The Chiroptera and Insectivora are usually placed immediately after the Primates. This must not, however, be taken as any indication that these groups really occupy a high position in the zoological scale; the fact, being that their organisation is of a low type, and far inferior to that of the modern Carnivora, though these are placed later.

The most obvious and most important characteristic of bats being their faculty of flight, and the apparatus for this being mainly furnished by the fore limb, the order to which they belong has been appropriately named Chiroptera, or hand-winged, from the Greek *cheir*, "hand," and *pteron*, "wing." In the great majority of mammals the hind limbs are as large as, or larger than, the front pair, but in bats the latter, shown in the figure of the skeleton, vastly exceed the former in length. In a bat's wing the humerus, or bone of the upper arm, is only moderately elongated, but the single complete bone in the forearm, corresponding to

the radius in man, has a far greater length, and this extraordinary elongation is carried still further in the bones of the hand, all of which, with the exception of those of the thumb, form long, slender rods. The thumb is free, and terminates in a hooked claw, which can be used for the purposes of climbing or suspension; but the fingers, of which the third is the longest, are connected by the delicate membrane



THE SKELETON OF A BAT

constituting the soft part of the wing. This wing membrane is continued along the arm and the sides of the body, and thence to the hind legs. There is also a similar membrane connecting the two hind limbs with the generally long tail; this membrane being usually supported by a peculiar spur of bone projecting from the foot. The toes, however, are quite free. In consequence of the connection of the hind limb with the wing membrane, the knee joint in bats is directed backwards instead of forwards in the usual manner; and this peculiar arrangement renders a bat's movements on the ground an awkward kind of shuffle. Most bats have a single pair of teats placed on the chest; and, as a rule, they produce only one or two young at birth, although in rare instances there may be three or four. As the young are always carried about clinging to the fur of the under surface of their parent, when there are three or four their united weight may exceed that of the mother.

In order to afford space for the attachment of the powerful muscles necessary to move the wings, the

chest of bats, like that of birds, is remarkably large. But as these animals are poor walkers, the haunch-bones are relatively small and weak.

The great majority of bats feed solely on insects, and have their cheek teeth furnished with a number of sharp cusps, admirably adapted for holding and piercing the tough covering of beetles and many other insects. A few bats, however, are blood-suckers, and these have the front teeth specially modified for piercing the skin of the animals they select as their victims. Others, and among them the largest representatives of the order, are fruit-eaters; and these accordingly have a quite different kind of cheek teeth, in which the crowns are nearly smooth and without cusps, but marked by a median longitudinal groove.

The number of the teeth in bats is variable, and is of great importance in distinguishing the different genera; but as some of these teeth may be exceedingly minute, their enumeration requires great care. No bat has more than two pairs of incisor teeth in the upper jaw; neither are there ever more than three premolars on each side of the upper and lower jaws, so that the number of teeth behind the tusks, or canines, never exceeds six. The milk teeth of bats differ remarkably from those of the permanent series, probably for the purpose of enabling the young ones to hold on to the nipples of their parents.

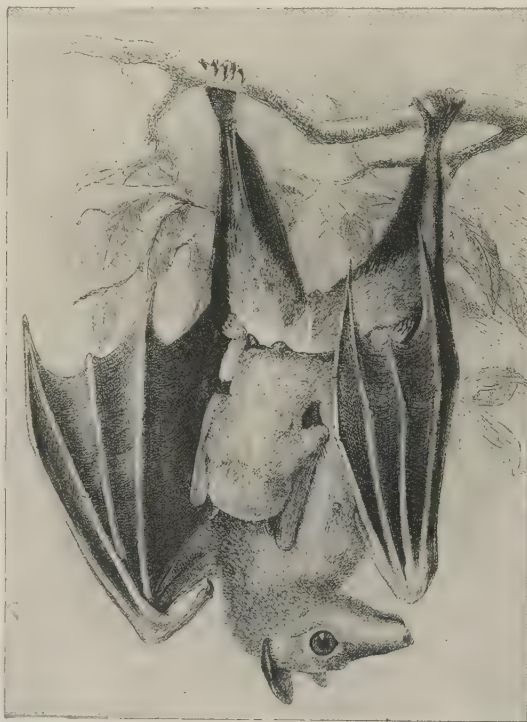
So thoroughly are bats adapted to a life in the air that most of them seldom resort to the ground, and even when they do so they generally endeavour to leave it as soon as possible by ascending a tree, rock, or wall, whence they either again take to flight, or settle themselves into their favourite position of repose. In some cases, bats when at rest suspend themselves head-downwards by the feet; but others hang by the claws of their thumbs in the normal position. It is often stated that bats are unable to take flight from a level surface, but this is an error. Most bats feed, and drink while on the wing.

In their active life bats being mostly nocturnal, while their eyes are relatively small, it is obvious that they must be provided with some special means of avoiding contact with objects during flight. This is effected by the extreme development of a sense more or less akin to the ordinary sense of touch, by which the neighbourhood of objects is perceived without actual contact; and the fact of the existence of such a special sense was demonstrated in 1793 by the Abbé Spallanzani, who resorted to the cruel experiment of depriving bats of sight and then allowing them to fly in a room across which silken threads were stretched in such a manner as to leave just sufficient space for them to pass between with outstretched wings. The bats not only succeeded in passing between these threads without contact, and likewise avoided the walls and ceiling of the room, but, when the threads were placed still nearer together, they contracted their wings in order to be able to pass without contact. In

the same manner they flew between branches and twigs of trees placed in their course, and suspended themselves when tired of flight on the walls of the room just as easily as when they enjoyed the use of their eyes. This special sense seems to be only an excessive development of one that exists in man. If, however, a person in the dark walks up against a wall or the trunk of a tree, he feels the presence of the obstacle before the actual impact, although too late to stop himself. The perception may be due to the compression of the air between the person's body and the obstacle.

In the great majority of bats this sense of touch is situated in the wing membranes and in the delicate and frequently enormously elongated ears, which are often provided with a kind of secondary inner ear, known as the tragus. Certain bats, however, have an additional organ of perception, which takes the form of expansions of skin from the nose and adjacent parts of the face, forming what is generally known as the

"nose-leaf," which is specially developed in the horseshoe bats and vampires. These folds of skin may be either comparatively small and simple, or so large as to form a kind of mask, communicating a really extraordinary physiognomy to the bats in which they occur. The various membranes forming these nose-leaves are always fringed with long and fine hairs, which evidently correspond to the "whiskers" of the cat; and these nose-leaves may be regarded merely as an excessive development of the cat's whiskers, accompanied by leaf-like growths from the skin of the nose. It has been observed that those species which are without nose-leaves are in the habit of flying at dawn or twilight, while the leaf-nosed kinds are more strictly nocturnal, and are much less frequently shot when on the wing. The fruit-eating bats, whose habits are very different from those of the other members of the order, never have these nose-leaves, and their ears are small and unprovided with the inner earlet, or tragus,



HOW A COLLARED FRUIT BAT CARRIES ITS YOUNG
From the "Proceedings" of the Zoological Society

there being no necessity for the extreme delicacy of tactile perception required in the other groups.

The difference in the duration of flight, however, is by no means confined to the horseshoe bats as distinct from ordinary bats; for some of the British representatives of the latter are on the wing only in the mornings and evenings, while others fly all night.

When on the wing, the ordinary insectivorous bats utter a short, sharp squeak of such an extremely high pitch that to many persons it is inaudible, although to others, whose ears are attuned to the reception of such high-pitched tones, these cries are of piercing intensity.

According to Mr. H. Elias, the shrill cries of bats are intimately connected with the structure of the larynx in these animals. Special features are the powerful musculature and the shortness of the glottis, the latter being the main cause of the shrillness of the cry.

The insect-eating species inhabiting the temperate regions, being dependent for their nourishment upon

GENERAL SKETCH OF THE BATS

a full supply of insects, must in winter either migrate to warmer regions or hibernate. In the British Isles all the species hibernate, and do not appear to migrate at all; and it is probable that this hibernating habit also holds good for the whole of the European bats. It seems, however, that at least one North American species—*Lasiurus borealis*—migrates to a certain extent during the summer, not visiting the more northerly portions of its habitat till August, when the long, intense twilights, which would be unsuitable to its habits, have ceased. In Canada at least two species of bats regularly perform extensive migrations in order to avoid the extreme cold of the northern winter.

On this subject Dr. C. H. Merriam observes that "all North American bats, except when their habits have been modified by proximity to man, may be classed as cave-dwelling or tree-dwelling, according to the places in which they spend the day. As a rule, the cave-dwelling species live in large colonies, while the tree-dwelling live singly or in small companies. Now, it is well known that the temperature in caves, even in high latitudes, is little affected by the external atmosphere, but remains nearly uniform throughout the year; while in holes in trees the temperature is about the same as that of the surrounding air. Hence, animals inhabiting caves can pass the winter much farther north than species living in hollow trees.

"The hoary bat (*Lasiurus cinereus*) is a tree-dwelling species, and its home is in the Canadian fauna, from the Adirondack Mountains northwards. Therefore, on purely theoretical grounds, it should be expected to migrate." Specimens of this bat have been not infrequently observed in the autumn and winter in localities so far to the south of its usual habitat that there would seem to be no longer any reasonable doubt as to its being truly migratory. It has, indeed, been found so far away from its ordinary summer haunts as the Bermudas, where Mr. J. M. Jones states that it is observed occasionally at dusk during the autumn months hawking about according to its nature in search of insects; but as it is never seen except at that particular season, it is clear that it is not a resident, but merely blown across the ocean by those violent north-west gales which also bring numbers of birds from the American continent. The hoary bat, however, is not the only species in which there is evidence of periodical migrations. The silver-haired bat (*Lasionycteris noctivagans*), for instance, which ranges as far north as Hudson Bay, is known to visit, every spring and autumn, a solitary lighthouse situated on an isolated rock off the coast of Maine, fifteen miles from the nearest island and thirty miles from the mainland. This rock being uninhabited permanently by bats, the occurrence of these stray individuals at the spring and autumn seems to afford conclusive evidence of the migratory habits of the particular species to which they belong.

In the case of the hoary bat and the silver-haired bat, it has been inferred that the seasonal migrations are of great length, as the bats are found in winter far southward of their breeding range. At Cape Cod, for instance,

these and other northern bats have been seen on the wing in evenings during August and September, whereas earlier in the season such species are unknown in that district. Till recently, however, only one naturalist appears to have observed bats actually on migration.

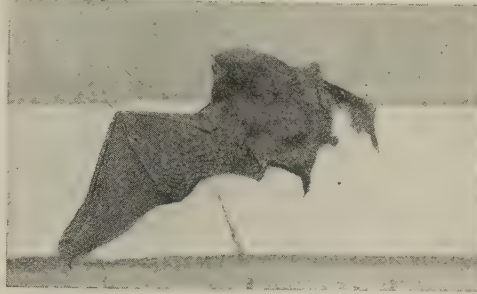
In 1898 Mr. F. A. Mearns stated that he had seen large flights of the red bat (*Lasiurus borealis*) on the wing in broad daylight during late October and early November, but gave no further particulars, although there was every probability that these flocks were really flying south. A fuller and more satisfactory account has been published by Mr. A. H. Howell, who

states that one morning near the end of September, 1907, he observed several bats flying at a considerable height over one of the suburbs of Washington. A few minutes later several more were seen, and between 9 a.m. and 10 a.m. it is estimated that about a hundred were observed, all flying in a south-westerly direction. These bats were not in flocks, but flying singly, usually four or five being in sight at a time. Their flight was quite different from that of ordinary occasions, being devoid of the usual zigzag movements,

and maintained steadily in one direction, with but little movement of the wings, in a kind of sailing or drifting manner. They were all so high that they looked like large butterflies rather than bats, although an examination with a field-glass revealed their true nature. Three sizes, probably indicating as many species, were noted, but most were of about the size of the red bat, and were doubtless either that species or the silver-haired bat. After having made inquiries from field naturalists with wide experience, Mr. Howell said that no other case has been observed of a flight of bats in which the southward migration was so clearly demonstrated.

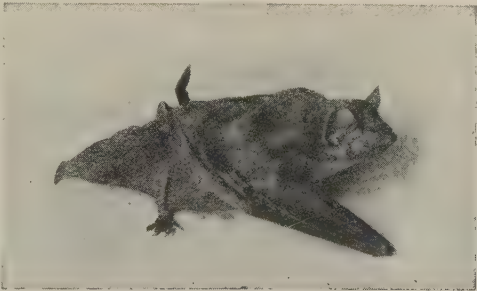
In connection with the cavern-dwelling species a most interesting account of a bat-haunted cave in Cuba is given by Mr. W. S. Palmer. The bats mostly belonged to a single species, *Phyllonycteris poeyi*, a member of the vampire family and peculiar to the island. The cave is situated on the side of a mountain, and entered by an aperture about a dozen feet in diameter, from which there is an abrupt descent. After going down 25 feet or so, the explorer and his companion found themselves some 20 feet above the lowest level of the cave. Although the noise they made was comparatively

slight, it was sufficient to arouse the bats, and the rumbling sound made by their wings was soon audible. As the explorers penetrated farther into the cave, the noise increased, until, when the innermost thickly populated chambers were reached, it became a rushing roar; thousands on thousands of the frightened bats flying wildly about the cavern. To reach the inner chamber, it was necessary to descend from the first landing to the real floor of the cave, and then light candles, for at this spot it was pitchdark. By this time all the bats were thoroughly aroused, and the noise of their wings was terrific; while the air was almost unbearable, stifling, and fetid. A faint idea of



PIPISTRELLE BAT WITH A WING UNFURLED
PREPARATORY TO FLIGHT

Photograph by F. Martin Duncan



NOCTULE BAT WALKING

Photograph by G. Bolam

the number of the bats may be gathered from the statement that, after blocking partially the exits by nets, the explorers, by merely swinging a landing-net backwards and forwards, were able to capture from twenty to thirty bats every quarter of an hour.

Tree-dwelling bats sometimes contrive to stow themselves into a very small space, as is evident from the following instance, which took place in May, 1908. During that month a large clump of dead bamboo was felled in the Botanical Gardens at Singapore. In the course of the work one of the coolies, while cutting the stems into lengths and splitting them, noticed a strange noise proceeding from the inside of one of the joints. On splitting this joint, three bats flew out, while others remained inside. When examined, the joint was found to be tenanted by no fewer than twenty-three bats, of which four were adult females and the remaining nineteen young ones; of the latter, one was still clinging to and suckling its parent. The bamboo joint was about one foot in length, with a diameter of a couple of inches. The partitions at the two ends were complete, and the only possible entrance was a crack on one side, which permitted a narrow strip to be pushed outwards, so that a triangular aperture, with a maximum diameter of a quarter of an inch, appeared in the upper partition. All the bats must have crept in through this minute orifice.

Other young bats of the same species were subsequently found in two joints in another clump of the same species of bamboo. In one of these joints, which had been lying exposed in the sun for several days, all the bats—some thirty in number—were dead and in a decomposed condition; they nearly filled the chamber. In the second, from which several had escaped, there was a number of young ones, together with one half-grown specimen. The bats were identified as *Vesperugo*, or *Tylonycteris pachypus*—a species remarkable for the extreme flatness of its skull, which would explain its passing through a fissure a quarter of an inch in diameter. That these bats are regular denizens of the interior of bamboos may be regarded as practically certain, and they thus afford a striking instance of structural adaptation to environment.

In the case of many bats, the colonies are formed entirely of one sex, this being notably so with the horseshoe bats. In regard to their geographical distribution, it may be observed that bats are found over almost the whole world; one species, at least, even extending so far northwards as the Arctic Circle. They are, however, far more abundant within the tropics and the warmer parts of the temperate zones than elsewhere; and it is to these regions alone that the larger species are restricted. Indeed, bats may be regarded as some of the most characteristic of the mammals of the tropical zone, occupying in this respect a position second only to that held by the apes, monkeys, and lemurs, and becoming suddenly much less plentiful, both as regards the number of individuals and of species in the temperate zones, and still more reduced in both respects in the colder parts of these regions.

In some instances particular groups of bats are



FLYING FOXES IN INDIA

confined more or less exclusively to particular regions of the earth's surface, although others enjoy an almost worldwide distribution. For instance, while the fruit bats are entirely confined to the warmer regions of the Old World, and the vampires and their allies to America, some of the more common types of ordinary European bats, like *Pipistrellus* and *Myotis*, are almost cosmopolitan. It will be found that these cosmopolitan forms belong to the more generalised types, while those restricted to particular districts are usually the more specialised form. It is somewhat curious that bats are quite unknown in Iceland, St. Helena, Kerguelen, and the Galapagos Islands.

The number of species of bats known to science is now enormous. In a list published in 1878 four hundred distinct species, arranged in eighty genera and six families, were recognised; but since that date the number has been so largely increased that it is probably about double. With such a portentous list to deal with, all that can be attempted here is to indicate some of the leading and more generally interesting types. The old English name "flittermouse," by which these animals were known in former times, and by which they are still designated in certain parts of England, conveys a very accurate notion of their zoological position, if we use the term "mouse" in the popular signification, in which it embraces animals like the shrewmice, as well as the true mice.

CLASSIFICATION OF THE BATS MENTIONED IN THIS WORK

Order II.

BATS—CHIROPTERA

SUBORDER I.

Fruit-eating Bats—Megachiroptera

FAMILY

Fruit Bats—Pteropodidae

GENUS 1

Flying Foxes—Pteropus

SPECIES

Indian flying fox *Pteropus medius*
 Nicobar flying fox *P. nicobaricus*
 Kalong *P. edulis*
 Australian fruit bat *P. poliocephalus*
 Polynesian flying fox *P. kerandrenii*
 Wallace's flying fox *P. wallacei*
 Red-necked flying fox *P. rubricollis*

GENUS 2

Tailed Flying Fox—Rousettus, or Xantharpyia

SPECIES

Collared flying fox *Rousettus collaris*

GENUS 3

Hammer-headed Bat—Hypsignathus

SPECIES

Hammer-headed bat *Hypsignathus monstrosus*

GENUS 4

Epauletted Fruit Bat—Epomophorus

GENUS 5

Short-nosed Fruit Bat—Cynopterus

SPECIES

Common short-nosed fruit bat *Cynopterus marginatus*

GENUS 6

Tube-nosed Fruit Bat—Cephalotes, or Harpyia

GENUS 7

Cusped-toothed Fruit Bat—Pteralopex

GENUS 8

Long-tongued Fruit Bat—Carponycteris

SPECIES

Small long-tongued fruit bat *Carponycteris minima*

GENUS 9

Eonycteris

SPECIES

Cavern long-tongued fruit bat *Eonycteris spelaea*

GENUS 10

Nesonycteris

SPECIES

Woodford's long-tongued fruit bat .. *Nesonycteris woodfordi*

SUBORDER II.

Insect-eating Bats—Microchiroptera

FAMILY 1

Horseshoe and Leaf-nosed Bats—Rhinolophidae

GENUS 1

Horseshoe Bats—Rhinolophus

SPECIES

Greater horseshoe bat *Rhinolophus ferrum-equinum*

Lesser horseshoe bat *P. hipposiderus*

Great Eastern horseshoe bat *R. luctus*

Australian horseshoe bat *R. megaphyllus*

South African horseshoe bat *R. capensis*

West African horseshoe bat *R. aethiops*

GENUS 2

Leaf-nosed Bats—Hipposiderus

SPECIES

Commerson's bat .. *Hipposiderus commersoni*

Himalayan leaf-nosed bat *H. armiger*

Duke of York Island leaf-nosed bat *H. calcaratus*

GENUS 3

Flower-nosed Bat—Anthops

SPECIES

Flower-nosed bat *Anthops ornatus*

FAMILY 2

False Vampires—Nycteridae

GENUS 1

False Vampires—Megaderma

SPECIES

Indian false vampire *Megaderma lyra*

Malay false vampire *M. spasma*

African false vampire *M. frons*

GENUS 2

Typical False Vampire—Nycteris

SPECIES

Javan false vampire *Nycteris javanica*

FAMILY 3

Typical Bats—Vespertilionidae

GENUS 1

Long-eared Bats—Plecotus

SPECIES

Long-eared bat *Plecotus auritus*

American long-eared bat *P. macrotis*

GENUS 2

Barbastelles—Barbastellus

SPECIES

Barbastelle *Barbastellus barbastella*

Himalayan barbastelle *B. darjilingensis*

GENUS 3

Eared Bat—Otonycteris

SPECIES

Hemprich's eared bat—*Otonycteris hemprichi*

GENUS 4

Nyctophilus

SPECIES

Australian *Nyctophilus*

New Guinea *Nyctophilus*

GENUS 5

Cave Bats—Antrozous

SPECIES

Californian cave bat *Antrozous pallidus*

GENUS 6

Pipistrelles—Pipistrellus

SPECIES

Pipistrelle *Pipistrellus pygmaeus*

Indian pipistrelle *P. abramus*

Noctule *P. noctula*

Hairy-armed bat *P. leisleri*

GENUS 7

Vespertilio—Vespertilio

SPECIES

Serotine *Vespertilio serotinus*

Parti-coloured bat *V. discolor*

GENUS 8

Lasionycteris

SPECIES

Silver-haired bat *Lasionycteris noctivagans*

GENUS 9

Lasiurus

SPECIES

Hoary bat *Lasiurus cinereus*

Red bat *L. borealis*

GENUS 10

Tube-nosed Bat—Harpyiocephalus

SPECIES

White-bellied tube-nosed bat *Harpyiocephalus leucogaster*

GENUS 11

Mouse-eared Bats—Myotis

SPECIES

Daubenton's bat *Myotis daubentoni*

Rough-legged bat *M. dasycneme*

Natterer's bat *M. nattereri*

Bechstein's bat *M. bechsteini*

Mouse-coloured bat *M. murinus*

Welwitsch's bat *M. welwitschi*

Hodgson's bat *M. formosus*

Whiskered bat *M. mystacinus*

GENUS 12

Pain'd Bat—Cerivoula

SPECIES

Indian painted bat *Cerivoula picta*

GENUS 13

Scotophilus

SPECIES

White-winged bat *Scotophilus albobfuscus*

GENUS 14

Miniopterus

SPECIES

Schreibers' bat *Miniopterus schreibersi*

GENUS 15

Tall-crowned Bat—Natalus

GENUS 16

Sucker-footed Bat—Thyroptera

SPECIES

Tricolour bat *Thyroptera tricolor*

GENUS 17

Sucker-footed Bat—Myzopoda

SPECIES

Golden Bat *Myzopoda aurita*

FAMILY 4

Free-tailed Bats—Emballonuridae

GENUS 1

Sheath-tailed Bats—Emballonura

SPECIES

Mountain bat *Emballonura monticola*

Polynesian sheath-tailed bat .. *E. semicaudata*

GENUS 2

Pouch-winged Bats—Saccopteryx

SPECIES

British Guiana pouch-winged bat .. *Saccopteryx leptura*

Brazilian pouch-winged bat *S. canina*

GENUS 3

Tomb Bats—Taphozous

SPECIES

Naked-bellied tomb bat *Taphozous nudiventris*

Sumatran tomb bat *T. affinis*

GENUS 4

White Bat—Diclidurus

SPECIES

White bat *Diclidurus albus*

GENUS 5

Hare-lipped Bat—Noctilio

SPECIES

Hare-lipped bat *Noctilio leporinus*

GENUS 6

Long-tailed Bat—Rhinopoma

SPECIES

Long-tailed bat *Rhinopoma microphyllum*

GENUS 7

Mastiff Bats—Molossus

SPECIES

Red mastiff bat *Molossus rufus*

Chestnut mastiff bat *M. glaucinus*

Long-eared mastiff bat *M. perotis*

GENUS 8

Naked Bat—Chiromela

SPECIES

Naked or Collared Bat *Chiromela torquata*

GENUS 9

Wrinkled-lipped Bat—Nyctinomus

SPECIES

Ceston's bat *Nyctinomus cestoni*

GENUS 10

New Zealand Bat—Mystacops

SPECIES

New Zealand bat *Mystacops tuberculatus*

FAMILY 5

Vampires—Phyllostomatidae

GENUS 1

Chin-leaved Bat—Chilonycteris

GENUS 2

Chin-leaved Bat—Mormops

SPECIES

Blainville's bat *Mormops blainvillei*

GENUS 3

Harmless Vampires—Vampirus

SPECIES

Great vampire *Vampirus spectrum*

Lesser vampire *V. auritus*

GENUS 4

Javelin Vampire—Phyllostoma

SPECIES

Common javelin vampire *P. hastatum*

GENUS 5

Long-tongued Vampire—Glossophaga

SPECIES

Sirew-like vampire *Glossophaga soricina*

GENUS 6

Fringe-tongued Vampire—Phyllonycteris

SPECIES

Sezekorn's vampire .. *Phyllonycteris sezekorni*

GENUS 7

Short-nosed Vampire—Artibeus

SPECIES

..... *Artibeus planirostris*

..... *A. persipillatus*

GENUS 8

Short-nosed Vampire—Stenoderma

SPECIES

Jamaican short-nosed vampire .. *Stenoderma achradophilum*

GENUS 9

Short-nosed Vampire—Centurio

SPECIES

Centurion Bat *Centurio senex*

GENUS 10

Blood-sucking Vampire—Desmodus

SPECIES

Common blood-sucking vampire ... *Desmodus rufus*

GENUS 11

Blood-sucking Vampire—Diphylla

SPECIES

Smaller blood-sucking vampire *Diphylla eudata*

THE FRUIT BATS

THE largest of all bats are the so-called flying foxes, or fruit bats, of the warmer regions of the Old World, which differ from the other members of the order in their purely frugivorous habits, and in certain details of structure partly caused by adaptation to their special mode of life. Since the fruit bats differ so essentially from the rest of the order, both in habits and structure, they are not only referred to a separate family—the *Pteropodidae*—but are likewise distinguished as a special suborder, appropriately termed the Megachiroptera, or large bats (pages 296, 300, 302).

As a group, fruit bats are marked by their generally large size, and by the peculiar nature of their teeth, as well as by certain features connected with the wings, ears, and tail. As regards the teeth, they are characterised by the molars having nearly, or quite, smooth crowns, elongated from back to front, and divided by a deep longitudinal groove; such a type of tooth being obviously as admirably adapted for mashing up pulpy fruits as the cusped teeth of ordinary bats would be unsuited.

The wings of fruit bats may be recognised from those of all other kinds by their having three (instead of one or rarely two) joints in the index finger; but the metacarpal bones, or those between the wrist and the fingers, must not be confounded with the proper bones of the latter. Moreover, the terminal joint of the second finger is generally provided with a claw; whereas in other bats the thumb alone is thus furnished. Then, again, a fruit bat may always be identified by its ears, of which the sides of the projecting portion, or conch, are united at the base so as to form a complete ring; the ears, as incidentally mentioned on page 298, being invariably of small size, and unprovided with an inner tragus.

The last distinctive feature of the group which it will be necessary to mention here is that the tail, if present at all, is always short, and situated beneath the membrane between the hind legs, with which membrane it may have no connection. Certain other characteristics require anatomical knowledge for their due appreciation, and are accordingly passed over.

Many considerations lead to the conclusion that the fruit bats form a specialised group, which have been derived by adaptation from ordinary insectivorous bats; and this view has been remarkably confirmed by the discovery of a peculiar species, which, while agreeing with the rest in the general structure of its molar teeth, differs in that these teeth retain cusps representing those of the insect-eating group.

The best known of the group are the flying foxes, so named from their long, fox-like faces. These bats, constituting the genus *Pteropus* of naturalists, are characterised by their large size, the presence of thirty-

four teeth—among which there are two pairs of incisors and three premolars in each jaw—the total absence of a tail, the long and fox-like muzzle, and the thick coat of woolly fur with which the neck is covered.

Flying foxes are found in India, Ceylon, Burma, the Malay Archipelago, the Seychelles, Madagascar, the Comoro Islands, the south of Japan, and most of the islands of the Pacific—the Sandwich and some other groups excepted—as well as in Papua and Australia. They are unknown in Africa, although common in the Comoro Islands, and even on Pemba Island, near Zanzibar.

Probably the most familiar of all the species is the Indian flying fox (*Pteropus medius*), characterised by its naked and sharply pointed ears. All who have resided in India have witnessed the long strings of these bats, which may be seen, as the shades of evening approach, wending their way from their sleeping-places to the scene of their nocturnal depredations. Writing of these bats, Dr. Jerdon stated that "during the day they rest on trees, generally in large colonies,

many hundreds often occupying a single tree, to which they resort if not driven away (page 300). Towards sunset they begin to get restless, move about along the branches, and by ones or twos fly off for their nightly rounds. If water is at hand—a tank, or a river, or the sea—they fly cautiously down and touch the water; but I could not ascertain if they took a sip, or merely dipped part of their bodies in. They fly vast distances occasionally to such trees as happen to be in fruit."

As the first streaks of dawn begin to appear in the east the bats set out on their homeward journey from the field of their depredations, and the scene which ensues on their arrival at their roosting-place is graphically described by Colonel Tickell: "From the arrival of the first comer until the sun is high above the horizon a scene of incessant wrangling and contention is enacted among them, as each endeavours to secure a higher and better place, or to eject a neighbour from too close vicinage. In these struggles the bats hook themselves along the branches, scrambling about hand-over-hand with some speed, biting each other severely, striking out with the long claw of the

thumb, shrieking and cackling without intermission. Each new animal is compelled to fly several times round the tree, being threatened from all points, and when he eventually hooks on he has to go through a series of combats, and be probably ejected two or three times before he makes good his tenure." When feeding, flying foxes hang by one foot only, and take the fruit they are about to eat in the other, seizing it by driving in their claws like a fork, and not by a grasping action.

This species of flying fox has an expanse of wing of



INDIAN FRUIT BATS

THE FRUIT BATS

about four feet from tip to tip; and it is found throughout the whole of India, Ceylon, and Burma. In the Andaman and Nicobar Islands in the Bay of Bengal, it is replaced by a species (*P. nicobaricus*) of nearly the same dimensions, but readily distinguished by its rounded ears.

The largest of all the flying foxes, and consequently of all bats, is the kalong, or Malay fox bat (*P. edulis*), which measures upwards of five feet from tip to tip of the wings, and derives its name from the fact that the flesh is eaten by the Malays; as, indeed, is that of its Indian cousin by some of the natives of that country. Dr. A. R. Wallace states that they are considered a great delicacy by the natives, and much sought after.

Of the Australian fruit bat (*P. poliocephalus*), Professor H. N. Moseley described a roosting-place which he visited in New South Wales: "In a dense piece of bush, consisting principally of young trees, the trees were hung all over with these bats, looking like great black fruits. As we drew near, the bats showed signs of uneasiness, and after the first shot were rather difficult to approach, moving from before us and pitching in a fresh tree some distance ahead. The bats uttered a curious cackling sound when disturbed. They were in enormous numbers, and although thousands had been shot not long before by a large party got together for the purpose, their numbers were not perceptibly reduced. They do great harm to the fruit orchards about Parramatta, and the fruit-growers there organise parties to shoot them."

The same observer also records that certain species of flying foxes which he met with in the Friendly Islands and in New South Wales are in the habit of devouring flowers as well as fruits. The particular species observed in the Friendly Islands was doubtless the Polynesian flying fox (*P. kerandrenii*), which is found in most of the islands in that region. "These bats," wrote Professor Moseley, "appear on the wing in the early afternoon in full sunlight, and at the time of our visit were feeding on the bright red flowers of one of the indigenous trees. Flowers form an important portion of the food of fruit bats. In New South Wales, in Botany Bay in May, numbers of fruit bats were to be seen feeding on the flowers of the gum trees.

"The bats most probably often act as fertilisers by carrying pollen from tree to tree adherent to their fur. As dark comes on, the fruit bats become more plentiful. It is probably only those specially driven by hunger that come out before dark." These observations show that some of these bats are, at certain seasons, in the habit of supplementing the ordinary fruit diet by one of flowers; but it does not appear that a similar habit has been recorded in the case of the Indian or Malay species. It has, however, been observed that the Indian flying fox will greedily drink palm juice from the pots hung on the trees for the purpose of collecting it; and some have been found lying at the foot of the trees in a helplessly intoxicated condition.

Wallace's flying fox (*P. wallacei*) is a native of the

island of Celebes, the red-necked species (*P. rubricollis*) comes from Mauritius, and there are many other kinds too numerous to mention.

THE TAILED FLYING FOXES

Closely allied to the last group are the tailed flying foxes, which are represented by a comparatively small number of species, forming the genus *Rousettus*, or *Xantharpyia*, and ranging from India, Burma, and the Malay islands to the Persian Gulf, Palestine, Africa, and Madagascar. They are distinguished from all the members of the genus *Pteropus* by the presence of a short tail, which is connected with the membrane between the legs, by their inferior size and less brilliant colouring, and by the fur on the back of the neck being no longer than that on the body. The collared flying fox (*R. collaris*, page 298), is a native of Equatorial and Southern Africa.

Many of these bats, instead of living in trees, inhabit caves or deserted buildings; one species being found in numbers in the chambers of the Great Pyramid in Egypt, as well as in old buildings in Palestine; while a second was observed in caves excavated in rock-salt in Kishm Island, in the Persian Gulf. Different individuals of a single species of these bats may apparently inhabit either caves or trees, and there is reason to believe that those dwelling in caves may be distinguished from those habitually frequenting trees by their shorter fur. Like most other members of the family, these bats travel long distances in their



MALAY FOX BAT

daily journeys for food; and it was at one time supposed that in Nepal they flew between thirty and forty miles out and home. This enormous distance, however, has been shown to be incorrect; the length of the daily journey really being about sixteen miles each way, or thirty-two miles in all.

HAMMER-HEADED BAT

Du Chaillu discovered in the Gabun a remarkable bat, to which the name of hammer-head was given in consequence of the shape of the head, which has an enormous muzzle, furnished in front with a sort of shield-like expansion, communicating to the whole face a repulsive and hideous expression. This bat (*Hypsignathus monstrosus*), like the epauletted fruit bats, has fewer teeth than the flying foxes, the total being twenty-six or twenty-eight. The hammer-head is wholly a fruit-eater, with a preference for figs. It lacks the shoulder-tufts of the following group.

EPAULETTED FRUIT BATS

The bats belonging to the genus *Epomophorus* are readily distinguished by the remarkably large and long head, with a bluntly conical or truncated muzzle, the very large, flabby, and expansile lips bordering a capacious mouth, and also by the presence of a tuft of white hair on the margins of the ears. Some of these bats are tailless, while others have a short tail,

disconnected with the membrane between the legs. The males are larger than the females, and are provided with peculiar pouches of skin on the sides of the neck, from the interior of which project tufts of long yellowish hair, surmounting the shoulders in such a manner as to suggest the appearance of epaulettes, from which feature is derived the popular name of the genus. These bats are confined to that portion of Africa south of the Sahara which constitutes the major part of the Ethiopian region of naturalists, and are unknown in Madagascar. Many of them feed largely on figs, their voluminous and capacious lips being admirably adapted to retain and swallow without loss the juicy contents of soft fruit during the process of mastication. They are now divided into several genera.

SHORT-NOSED FRUIT BATS

The short-nosed fruit bats of the genus *Cynopterus* comprise several species almost exclusively confined to the Oriental region—that is to say, ranging from India to the Malay islands—and readily distinguished from the flying foxes by their short and rounded muzzles, marked by a shallow vertical groove, and their small size. The teeth are, moreover, somewhat less numerous than in the latter, being usually thirty-two, but occasionally, owing to the absence of one pair of lower incisors, only thirty. They have generally a short tail, with the same relations to the membrane between the legs as in the tailed flying foxes.

The common short-nosed fruit bat (*Cynopterus marginatus*), ranging from India to the Philippine Islands is one of the best-known forms, and remarkable for its extreme voracity. It is very common throughout India, where it generally inhabits trees—especially the palmyra palm—but is sometimes found in caverns and crevices of rocks. This bat is very destructive to fruit, being especially fond of plantains and mangoes. As an example of its greed, it may be mentioned that an individual, of which the weight when killed some hours after the feast was only one ounce, consumed two and a half ounces of plantains within a period of three hours. The flight of this species is much lighter than that of the flying foxes, although the habits of the two groups are very similar.

TUBE-NOSED BATS

Certain curious bats, differing from one another considerably in size, and found from Celebes to New



ABYSSINIAN EPAULETTED BAT

Guinea, North Australia, and New Ireland, belong to the genus *Cephalotes*, or *Harpyia*, and are distinguished from the short-nosed fruit bats by their still shorter and more rounded muzzles, but more especially by the production of the nostrils into a pair of long diverging tubes, reaching rather beyond the extremity of the muzzle. Apparently no suggestion has been made yet as to the reason for this prolongation of the nostrils, although it must be of some special advantage. Of the habits of these bats we possess practically no information, but they are further distinguished by the small number of teeth, of which the total is only twenty-four.

CUSPED-TOOTHED FRUIT BAT

In the Solomon Islands is found a somewhat large species of bat, *Pteralopex atrata*, which is remarkable for the peculiar structure of its teeth. This bat is of a uniform dark brown colour, and has the general characters of the flying foxes, with which it also agrees in the number of its teeth, but the muzzle is much shorter and thicker. The peculiarity of the teeth is that the molars have a series of cusps, almost obliterating the longitudinal grooving characteristic of those of all fruit bats. The presence of these cusps suggests that the cusped-toothed fruit bat may be the descendant of a connecting form between the insect-eating bats and the fruit bats; and it is upon the evidence of this species that naturalists now regard all fruit bats as derived from bats with fully cusped teeth like those of the insectivorous species. The Solomon Islands form a group lying to the east of New Guinea, and extending in a south-easterly direction from New Ireland; and it is just such remote spots that are most favourable for the survival of ancient connecting types of animals like this genus.

LONG-TONGUED FRUIT BATS

All the fruit bats hitherto noticed are characterised by a tongue of moderate dimensions and well-developed molar teeth. There is, however, a small group, comprising several species, all distinguished by long and slender tongues, terminating in recurved papillæ, and likewise by exceedingly narrow molar teeth, which scarcely project above the level of the gums. All have long and sharply pointed faces. With the exception of one West African species, the long-tongued fruit bats are confined to the Indian, Malay, and Australian regions, extending from India itself to New Guinea and the Solomon Islands, and they are found on the continent of Australia. They are of relatively small size as compared with the flying foxes. The use of the long tongue is unknown, but since it can be



INDIAN SHORT-NOSED FRUIT BAT

INSECT-EATING BATS

protruded some distance in advance of the muzzle, it may be that it is employed to lick out the contents of soft fruits while still hanging on the trees; this theory is confirmed by the small size of the molar teeth, which can be of little service in mastication.

The small long-tongued fruit bat (*Carponycteris minima*) is the smallest of all the fruit bats; being considerably inferior in size to the European noctule described later. The geographical distribution of this or a nearly allied species is very extensive, ranging from Northern India and Burma to Australia and New Ireland. It is common in the warm valleys of Sikkim,

and generally roosts in trees, although occasionally found in old buildings. It lives on fruit of all kinds, of which it consumes, in proportion to its size, a large quantity. The cavern long-tongued bat (*Eonycteris spelæa*) is a rather larger species, distinguished by the absence of a claw on the index finger. It inhabits caves in Burma, Java, and Cambodia. The only other species needing mention here is Woodford's fruit bat (*Nesonycteris woodfordi*), from the Solomon Islands, remarkable for its brilliant colouring, the body and hairy portions of the limbs being bright orange, while the wing membranes are dark brown.

INSECT-EATING BATS

HAVING treated of bats which feed entirely upon fruit or flowers, we now come to the consideration of the much larger group of those which subsist upon insects, among which are included a few which have acquired frugivorous habits, and likewise those which subsist by sucking the blood of mammals larger than themselves. As being generally of much smaller size than those of the frugivorous group, the members of the insectivorous group are collectively known as Microchiroptera; and some of the leading characteristics, other than those of an anatomical nature, may now be mentioned.

Apart from their generally inferior bodily size, insectivorous bats are broadly distinguished from fruit bats by the presence of a number of sharp cusps on the crowns of their molar teeth, these cusps in the upper molars taking the form of the letter W. There is no trace of the longitudinal groove found in the molars of the fruit bats, the upper molars having their longer diameter placed transversely instead of longitudinally.

Another distinctive feature is to be found in the index finger of the fore limb, which has never more than two joints, and usually contains but one, which never terminates in a claw, as it frequently does among the fruit bats. Then, again, the head of an insect-eating bat may be recognised by the two margins of the conch of the ear arising from the head from separate points, instead of forming a complete ring at the base as in the fruit bats. Moreover, the tail, which is very generally present and of considerable length, is either contained in the membrane joining the hind limbs or visible on the upper surface of the same.

The insect-eating bats are divisible into two minor sections, distinguished from one another by several easily recognised features. In the first section one of the chief characteristics is that the tail is included within the membrane between the hind legs. Another is that the inner pair of incisor teeth in the upper jaw are never very large, and are always separated from one another in the middle line by a considerable space. Yet another characteristic, with the exception of three species (belonging to as many genera), is that the third, or middle, finger has only two bony joints; to which it may be added that when the animals are at rest the first joint of the same finger is invariably extended in the same line as its supporting metacarpal bone.

HORSESHOE AND LEAF-NOSED BATS

The greater horseshoe bat is one of the two British representatives of a well-marked and rather numerous family distributed over the larger part of the Old World. This family is technically known as the *Rhinolophidæ*,

and includes the horseshoe bats (*Rhinolophus*) and the leaf-nosed bats (*Hipposiderus*), together with some less important genera. All are characterised by the well-developed nose-leaf completely surrounding the nostrils, which are situated in a depression of the snout; and they are also distinguished by large ears, which have no trace of an inner ear, or tragus, and are in most cases separate from one another at their origin on the head.

The horseshoe bats always have 32 teeth, of which the incisors number $\frac{1}{2}$, the canines $\frac{1}{2}$, and the cheek teeth $\frac{5}{2}$ on each side; and they are further distinguished by the shape of the nose-leaf, which consists of two portions, the one immediately over the nose being horseshoe-shaped, while the hind one is pointed.



THE TUBE-NOSED BAT

The ears are characterised by the presence of a large process of membrane in front termed the antitragus.

The greater horseshoe bat (*Rhinolophus ferrumequinum*) has a very wide distribution, being found over a large portion of Europe, the greater part of Africa, and Asia north of the Himalaya, and as far east as Japan. In England, although nowhere common, it is met with in the southern counties, and is occasionally found in the Midlands, but is unknown farther north, and has never been observed in Ireland. Like the other species, it prefers to rest during the day in caves and old buildings, and does not issue forth till late in the evening, when it continues its flight till dark.

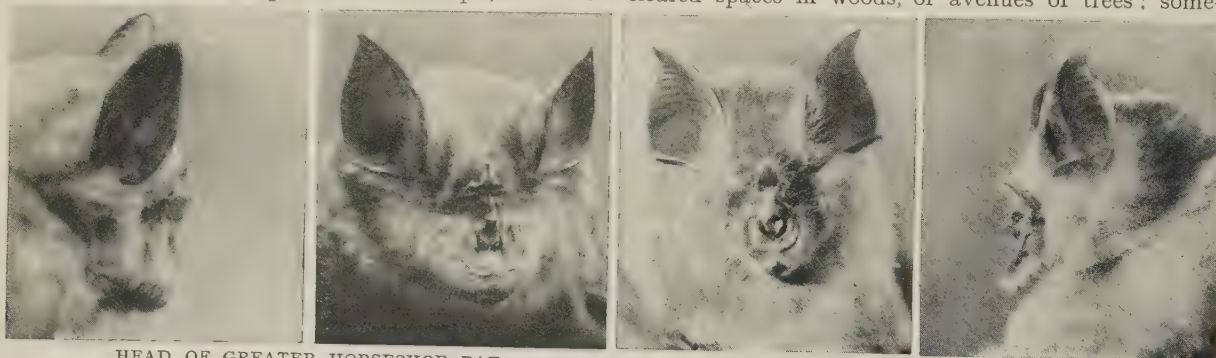
The second British representative is the lesser horseshoe bat (*R. hipposiderus*), which ranges over a large part of Europe, extending as far north as the Baltic. Numbers of these bats take up their quarters in the roof of Wells Cathedral. The species has been recorded from Ireland, and is also found at Gilgit, on the north-west of India; in Africa it does not extend south of the Sahara. During the day it hides in caves, ruined buildings, outhouses, etc. It usually appears about dusk, and has a powerful and long-sustained, although rather irregular and fluttering, flight. It generally flies rather higher in the air than the greater horseshoe bat, and is more frequently found away from dense tree-growth.

English and Irish specimens of the lesser horseshoe bat differ from Central European examples in their generally inferior size, the average size of the British race being considerably below the minimum of the typical form. In 1808 George Montagu, who was unaware of the existence of the name *Hipposiderus*, designated the British lesser horseshoe bat *Vespertilio minutus*, and this race accordingly now becomes *Rhinolophus hipposiderus minutus*. The lesser horseshoe bat probably originated somewhere in Southern Asia from a species allied to the one known as *R. minor*, and the Continental form has developed into the large typical race, while the British representative forms a diminutive type. From the fact that the lesser horseshoe bat is distributed over the whole of England, and also occurs in Ireland, it has been suggested that it was an earlier arrival in England than the greater horseshoe bat, which is restricted to the south of England and Wales, apparently not extending farther north than Essex, Gloucestershire, and Pembroke. Of this species several local races are recognised, and the British form is, as compared with the typical Continental race, somewhat smaller.

The largest of all the species is the great eastern horseshoe bat (*R. lucius*), which is found in elevated districts from India to Borneo and the Philippine Islands. It has a very large and peculiar nose-leaf, the anterior part of which spreads over the lips; and the

in a point, and there is also no median process hiding the nostrils. The large, leaf-like antitragus found in front of the ears of the horseshoe bat is also reduced to a very small remnant; and the teeth, owing to a reduction in the number of the premolars, are fewer than in the horseshoe bats, the total number being either thirty or twenty-eight.

Leaf-nosed bats are unknown in Europe, although widely spread over the warmer regions of Africa, Asia, and Australia. Some exceed in size the largest of the horseshoe group; the biggest of all being Commerson's bat (*H. commersoni*), from Africa and Madagascar, next to which is the great Himalayan leaf-nosed bat (*H. armiger*), extending from the Eastern Himalaya to China. Males of this species are just over four inches in length, exclusive of the tail. The following is Dr. J. Scully's account of the habits of the last-named species: "This bat usually harbours during the day in caves, or commonly in lofts, outhouses, and sheds that are little used; in the latter localities it suspends itself, by the claws of the feet, from the rafters. When attaching itself in this way to the edge of a beam or rafter, the animal sways, pendulum-like, a few times until the impetus given during flight is exhausted; and it then hangs motionless, with its wings folded close to the body. It comes out for the capture of its prey about sunset, and its hunting-grounds are gardens, orchards, cleared spaces in woods, or avenues of trees; some-



HEAD OF GREATER HORSESHOE BAT

Photographs by Douglas English

HEAD OF LESSER HORSESHOE BAT

colour of the fur and wings is generally jet black. These bats, which generally go in pairs, instead of in flocks, although several pairs may not infrequently be found in large caves, begin their flight early in the evening, and fly at a height of about twenty or thirty feet above the ground, their movements being somewhat heavy and slow.

There are many other species of horseshoe bats, among which is one (*R. megaphyllus*) peculiar to North-East Australia, a second (*R. capensis*) is confined to South Africa, extending as far north as Zanzibar, and a third (*R. æthiops*) is peculiar to West Africa. In the colder regions of their habitat all the species of *Rhinolophus* hibernate; but in Malta the lesser horseshoe bat, which on the Continent retires for the whole winter, may be observed at any season, although, of course, most plentiful in summer, and even in mid-winter occasionally ventures forth at twilight when the warm southern winds are blowing. The horseshoe bats, with their near allies, the leaf-nosed bats, may be regarded as the most highly organised of the entire insectivorous group, as is especially indicated by the great development of their nasal appendages, as well as by their compact and delicately formed bones.

The leaf-nosed bats (*Hipposiderus*) are distinguished from the horseshoe bats by the form of the nose-leaf, in which the upper and hind portion does not terminate

where near trees always. It is sometimes found flying on a level with the tops of the trees, but more commonly nearer the ground; a very characteristic movement is a slow but steady sweep round a leafy tree, or clump of trees, in search of insects which frequent the lower branches." *H. calcaratus* is a native of the Duke of York Island, in the New Ireland group.

In addition to the true leaf-nosed bats, of which there are many species, there are several more or less closely allied kinds referred by naturalists to distinct genera. The only one of these demanding special mention is the flower-nosed bat (*Anthops ornatus*) of the Solomon Islands (page 307), remarkable for the extraordinary development of its nose-leaf. This appendage assumes the form of a large rosette, covering the whole front of the face, reaching from eye to eye, and extending downwards nearly to the upper lip. Above the eyes the upper border of this rosette terminates in three stalked balls, while the remainder consists of overlapping furbelow-like expansions of skin; the obliquely placed nostrils appearing somewhat below its centre. It is difficult to believe that such a structure is solely connected with the sense of touch, and it therefore seems that in this case the great development of the rosette may, to a large extent, be nothing but an ornamental feature.

FALSE VAMPIRE BATS

CERTAIN bats agreeing with the preceding group in the possession of a nose-leaf, and found in the tropical and subtropical parts of Africa, India, and the Malay region, are—from the blood-sucking propensities of at least one of the species—commonly known as vampires; but, since that term leads to confusion with the true American vampires, they are better designated false vampires. The species, together with those of another genus, collectively constitute the family *Nycteridae*.

All the members of this family are distinguished from the horseshoe bats and their allies by the presence of a large tragus in the long ears, and also by the smaller development or practical absence of the nose-leaf.

The false vampires (*Megaderma*) are recognised by their enormous ears being united for a longer or shorter distance by their inner margins, and also by the divided tragus and tall nose-leaf. The tail is so small as to be practically invisible, and they have no upper incisor teeth; the total number of teeth being twenty-eight or twenty-six, of which the incisors number 2, the canines 1, and the cheek teeth either $\frac{2}{5}$ or $\frac{1}{5}$ on each side.

One of the best-known species of the group is the Indian false vampire (*M. lyra*), which is found throughout India, from Kashmir to Ceylon, and reappears in China. Decisive evidence of its blood-sucking propensities was obtained by Mr. E. Blyth, who on a particular occasion saw one of these bats fly into his house with a smaller bat in its mouth, which it dropped when pursued. The captured bat was weak from loss of blood, and when put next morning into a cage with its captor was at once attacked by the latter, being seized behind the ear and speedily devoured. Canaries in Rangoon have also been killed by bats probably belonging to this species—an inference which, if correct, proves the occurrence of this bat in Burma.

In correspondence with their different habits, the jaws and lips of this species, as well as of the other false vampires, differ considerably from those of ordinary insect-eating bats; and it may accordingly be assumed that all the species partake more or less extensively of an abnormal diet. The large Indian false vampire, which, like the other

species, has no tail visible externally, measures from 3 to $3\frac{1}{2}$ inches in length, while its extended wings have a span of from 14 to 19 inches.

A second species, the Malay false vampire (*M. spasma*), extends from the Malay region and Tenasserim to China, and two others are found in Africa. One of the latter (*M. frons*), characterised by the great height of the nose-leaf, and also by the length of the tragus of the ear, ranges from the west coast to Khartum, and has the peculiar habit of covering its wings and the fur of the back with a sticky, orange-coloured powder secreted by a gland on the rump.

When flying early in the evening, these bats look like great yellow butterflies. These African species have one more upper premolar tooth than the Oriental forms, and are in consequence referred by some naturalists to a separate genus, under the name of *Lavia*.

The bats forming the typical genus *Nycteris* are readily distinguished from the false vampires by the practical absence of a distinct nose-leaf, which is represented only by a slit running down the middle of the face from the nostrils to the line of the ears, on the sides of which are small expansions of skin. The ears, although furnished with an undivided tragus, are merely joined by a very narrow band at their bases, which in some species is so slightly developed as to be almost invisible. These bats have well-developed tails, and also upper incisor teeth, the total number being 32, of which $\frac{2}{5}$ on each side are incisors, 1 canines, and $\frac{1}{5}$ cheek teeth. So different, indeed, are the bats of

this genus from the false vampires, that the reader might well wonder why the two are associated in a single family. There are, however, important resemblances in the form and structure of the head and skull, among which—as characters visible externally—may be mentioned the pointed and cylindrical muzzle, and the projection of the lower jaw beyond the upper;

these being sufficient to establish the near relationship of the two groups. Excepting one species (*N. javanica*) from Java and the Malay Peninsula, the bats of this genus are confined to Africa, mostly south of the Sahara, although one ranges into Egypt.



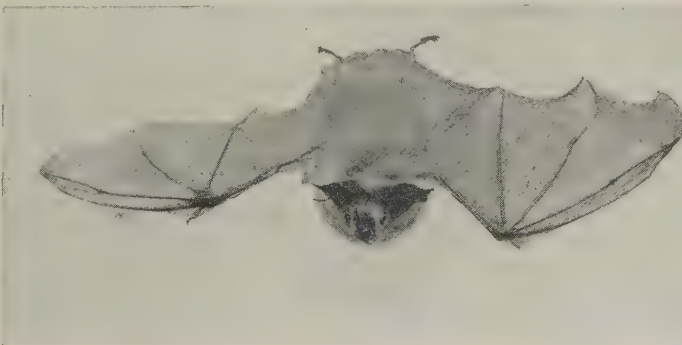
THE FLOWER-NOSED BAT OF THE SOLOMON ISLANDS



FACE OF FLOWER-NOSED BAT



HEAD OF INDIAN FALSE VAMPIRE BAT



AFRICAN FALSE VAMPIRE BAT

TYPICAL BATS

WITH the exception of the horseshoe bats, all the bats found in the British Islands, and, indeed, in Europe generally, are included in a single family, and may be designated typical bats, although scientifically known as *Vespertilionidae*. All these bats agree with the members of the two preceding families in the relation of the tail to the membrane between the legs, but are distinguished by the absence of a distinct nose-leaf, the nostrils merely forming circular or crescent-shaped apertures at the end of the muzzle without any complications from foldings of the skin. The tail is long, and produced to the edge of the membrane between the legs; and the ears are always furnished with a distinct tragus. The incisor teeth of the upper jaw are always of small size, those of opposite sides being separated from one another by a considerable interval, while their number varies from one to two pairs. The lower incisor teeth, on the other hand, are, with one exception, three pairs. There are generally either six or five cheek teeth on each side of both upper and lower jaws, the reduction in number in the latter instance being due to the disappearance of one of the premolars.

In addition to being the common bats of Europe, the typical bats have an almost worldwide distribution, and include a very large number of distinct species. The absence of the nose-leaf, along with other features in their organisation, indicates that they are less specialised types than the two preceding families, to which, however, they are in other respects intimately related. It has accordingly been suggested that the typical bats are the descendants of the ancestral forms which give rise both to the *Nycteridae* and the horseshoe and leaf-nosed bats, so that all these three families may be regarded as forming a single distinct branch of the insectivorous bats; the main stem of this branch being formed by the *Vespertilionidae*, and the other two families forming side branches. The number of these bats being so great, all that need be attempted here is to select a few of the better-known examples of some of the more important genera.

LONG-EARED BAT

The well-known long-eared bat (*Plecotus auritus*) is a common British species, easily recognised by the great length of its delicate ears. It is the typical representative of the genus *Plecotus*, which, with certain allied genera, is characterised by the presence of grooves, or incipient nose-leaves, on the upper part of the muzzle behind the nostrils; and also by the ears being generally very large, and united by their inner margins.

The long-eared bat has 36 teeth, of which $\frac{2}{3}$ on each side are incisors, and $\frac{2}{3}$ cheek teeth; the premolars being, what is very rare in the family, $\frac{2}{3}$ in number. The

ears, which are more than twice the length of the head, are united for a considerable distance; their tragus being also large. The general colour, like that of all British bats, is sombre, being brownish grey above and paler on the under parts. Till recently this bat has been regarded as having a very wide geographical distribution, extending over the greater part of Europe, Northern Africa, and probably most of the temperate regions of Asia, and thus reaching from Ireland in the west to the Darjiling Himalaya in the east. The Indian form, however, has been separated as a distinct species, although it is more probably only a race.

In the great development of its ears, as well as in the presence of groovings on the nose—which in other forms of the group develop into incipient nose-leaves—the long-eared bat and its allies occupy the highest, or most specialised, position among the typical bats. This large size of the ears is in all probability connected with the nocturnal habits of the species; and

it would appear that these organs to a large extent serve the same purposes as the large nose-leaves of the horseshoe bats. The long-eared bat is mainly nocturnal in its habits, and although it may often be seen hawking after flies with the short-eared pipistrelle in the evening, yet it is late in coming forth from its diurnal resting-place, and its flight is continued throughout the night. The presence of this bat may be recognised by its cry, which, when once known, can always be distinguished from that of other species, and may be heard at all hours of even the darkest night, whether the listener be in the fields, or in the neighbourhood of woods, or near towns. The cry is acute and shrill, although not loud; but practice only can enable observers to distinguish it from that of other bats.

In order to protect them from injury during the time that their owner is at rest,

the long and delicate ears are generally carefully folded away beneath the wings (page 309); and since the upright tragus is then left standing alone, the creature looks as if it had only short and slender ears. The ears both of this bat and of its North American ally are relatively longer than in any other animal; and it is, indeed, probably solely due to the adventitious width communicated to the body by the wings that the ears do not appear monstrous and out of all proportion. The long-eared bat is a comparatively small species, the length of the head and body being just short of 2 inches; while the ear measures about $1\frac{1}{2}$ inches, and the spread of the expanded wings reaches 10 inches.

From observations made in the disused copper-mines of Alderley Edge, it appears that in the case of the long-eared bat the winter sleep is interrupted, the bats probably feeding at intervals on the insects which abound in the tunnels in winter, even if they do not



HEAD OF THE LONG-EARED BAT

Photograph by F. R. Hinkins & Son

THE BARBASTELLE

venture forth into the open. The same is probably true of Daubenton's bat, the whiskered bat, and the lesser horseshoe bat.

The favourite hiding-places of these bats in inhabited districts are church towers, or the roofs of open buildings or outhouses; and in such places they may be found in the daytime during the summer months hanging in large clusters, and in the winter carefully ensconced in such crannies and nooks as afford the best protection. In a rock-cut tomb in the Libyan Desert visited many years ago by Leith Adams, the long-eared bats, which were at that time regarded as distinct from the present species, were met with in swarms; so plentiful, indeed, that during his descent into the crypt the explorer was covered with them, while hundreds fluttered about like bees around a hive. In North America and Vancouver Island, the long-eared bat is represented by an allied species, the American long-eared bat (*P. macrotis*), readily distinguished by certain peculiar gland-like swellings in the region of the nose. Its general habits appear to be very similar to those of the European species.

THE BARBASTELLE

The barbastelle (*Barbastellus barbastella*) appears to be one of the rarest of all the British bats and represents a distinct genus. This bat (page 310) is distinguished from the long-eared species by the comparatively small size of its

ears, while the skull has only thirty-four, in place of thirty-six, teeth, this reduction being due to the disappearance of one pair of premolars from the lower jaw. A further point of difference is to be found in the fact that, whereas in the long-eared bat the outer margin of the ear terminates suddenly near the corner of the mouth, in the barbastelle it is produced forwards, so as to extend above the mouth to the front of the eye.

The barbastelle is found over Middle and Southern Europe, as far north as England and Sweden, and has also been obtained from North Africa and Arabia, while it may extend into the temperate regions of Asia lying to the north of the Himalaya. When examined closely, the appearance



LONG-EARED BAT ABOUT TO SLEEP
(1)



(2) DOZING OFF—ONE EAR
TUCKED UP

of the head of the barbastelle is so peculiar as to render its recognition always an easy matter. The muzzle is abruptly truncated and marked by a groove leading up each side to the nostrils; the latter being situated in a depression void of hair on the upper surface of the muzzle. The black hair on the somewhat swollen cheeks also adds to the peculiarity of the physiognomy, while the ears are relatively broad, and nearly equal in length to the head. The long fur is darker than that of any other European bat, and on the upper parts is brownish black, with the points of the hairs lighter, while on the under parts the light tips of the hairs are longer. The length of the head and body is 2 inches and that of the ears half an inch.

A white example of this bat has been recorded, and another in which, while the head and neck were of the normal tint, the body was white. The barbastelle is a solitary species, both when in repose and during active life. It appears earlier in the evening than the long-eared bat, and probably retires as the night advances.

The Himalayan barbastelle (*B. darjilingensis*) is distinguished from its European congener by its larger ears, which lack the projecting lobe found on the outer margin of those of the latter. This bat appears to be common in the Himalaya, and has been captured in localities so far apart from one another as Gilgit and Darjiling. It is generally found at altitudes varying from about five thousand to eight thousand feet above the sea. In habits, the Himalayan barbastelle appears to be very similar to its European relative, showing itself, however, rather late in the evening, and hibernating in the narrowest crevices and chinks of rocks into which it can contrive to crawl. Other bats allied to the long-eared bat and barbastelle are referred to three distinct genera. One of these is Hemprich's eared bat (*Otonycteris hemprichi*) from Northern Africa and the North-West Himalaya, characterised by having only thirty teeth, owing to the reduction in the number of the upper incisors and premolars to a single



(3) ASLEEP—BOTH EARS FOLDED AWAY

Photographs by J. J. Ward



THE BARBASTELLE

pair each. Its ears are considerably longer than the head. The second genus, *Nyctophilus*, includes one species from Australia and a second from New Guinea, which, while possessing the same number of teeth as Hemprich's bat, are distinguished by the possession of a rudimentary nose-leaf. The Californian cave bat (*Antrozous pallidus*), in which there are only twenty-eight teeth, owing to the reduction of the number of the lower incisors to two pairs (a feature unique among the typical bats), is also distinguished from all the members of the family hitherto mentioned by the ears being disconnected with one another.

THE PIPISTRELLE

The pipistrelle (*P. pygmaeus*) and noctule are two of the best-known British representatives of the large and widely distributed genus *Pipistrellus*; the pipistrelle being the common English bat (page 299). With these bats we enter upon the consideration of a group of genera distinguished by several more or less important features, among which may be mentioned the simple nature of the nostrils. These are without any trace of groovings or foldings of the skin, while the ears are usually of comparatively small size and always separate from one another.

The pipistrelle and its immediate relatives may be easily recognised by their relatively stout bodies, broad and flattened heads and blunt muzzles, as well as by the broad, short, and triangular ears, in which the tragus is generally rather thick and inclined somewhat inwardly. Their legs are unusually short, and the membrane connecting the legs with the tail almost always has a small supplemental portion situated on the outer side of the spur rising from the heel.

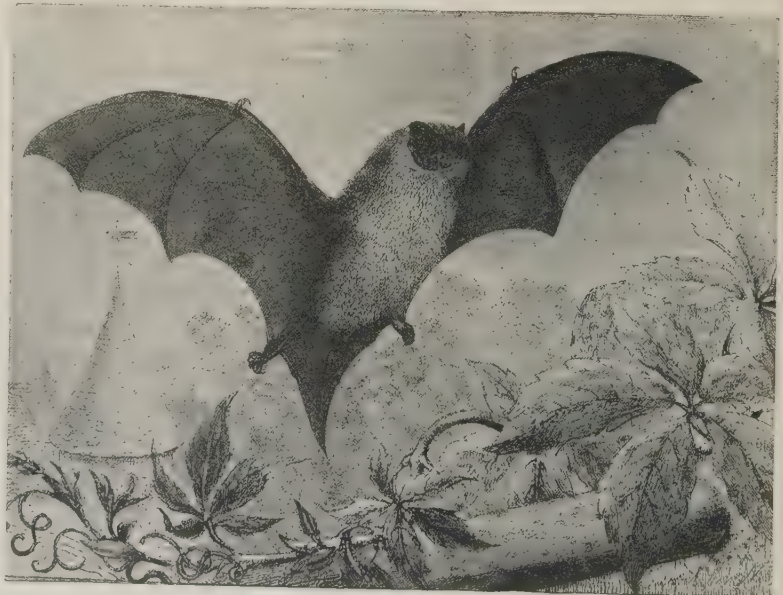
This genus probably contains the greatest number of individuals among the bats. The common bats of all countries, especially those lying within the tropical and subtropical regions of the Northern hemisphere, as a rule belong to this group. The colour of the

fur is generally dark brown or black, the extremities of the hairs being of a paler colour on the upper surface, and ashy or whitish beneath.

The pipistrelle is characterised, like its relatives, by possessing $\frac{3}{4}$ incisors and $\frac{3}{4}$ premolar teeth on each side of the jaws. It is a small species, measuring 1.65 inches in length of head and body, and with a span of wing of about 8.5 inches. The fur is rather long and silky, of a yellowish red colour near the roots of the ears, but elsewhere reddish brown above and dusky beneath. This bat, the smallest of the British species, is distributed all over Europe, the temperate parts of Asia, and Northern Africa. It does not enter India, but is found in the valley of Kashmir and also at Gilgit.

The pipistrelle appears earlier and retires later than any other English bat, making its first appearance so early as the middle of March, and not finally hibernating till winter has actually set in. Its flight is extremely swift and rapid, and accompanied by sudden turns and descents. Its favourite resorts in inhabited regions are old buildings and roofs, but it avoids the roofs of stacks and ricks, which might have been thought to afford safe cover. Possibly this avoidance is due to the rats and mice so frequently found in such situations. Trees are seldom selected either as a temporary hiding-place or for hibernation. In uninhabited districts crannies and clefts in rocks afford shelter. The favourite food of the pipistrelle is gnats, and the abundance of these insects on some of the warmer days of winter is probably the reason why one or more of these bats may occasionally be seen flying about at that season. In captivity this bat will readily eat meat. Other small bats may also at times be seen during the winter in England.

In India the place of this bat is taken by the closely allied Indian pipistrelle (*P. abramus*), which also ranges as far east as Northern Australia and, in summer at least, as far west as Central Europe. It may be



THE PIPISTRELLE

THE GREAT BAT, OR NOCTULE

distinguished from the common species by the outer margin of the ear being straight, instead of concave, below the tip. As the pipistrelle is the best-known bat in England, so its Eastern representative is probably the most abundant species in India, where it ranges from the Himalaya to Ceylon. Its habits are similar to those of the ordinary species, similar partiality for human dwellings being exhibited, and the flight being characterised by the like sharp doublings and turns.

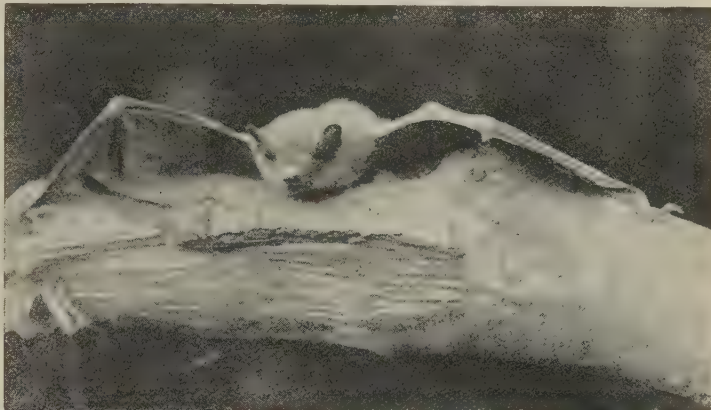
THE NOCTULE

The great bat, or noctule (*P. noctula*), the next to claim notice, is perhaps the most familiar of the larger British bats. As it belongs to a group distinct from the one containing the pipistrelle, it is often referred to a separate genus (page 299). Apart from size, it is distinguished from the pipistrelle by its broad and rounded ears, which are set very far apart on the head. The colour of the upper parts is yellowish brown, only very slightly paler below, but some examples have a reddish tinge. The length of the head and body is 3 inches, and the spread of the wings from 13 to more than 14 inches. It has a wider distribution than the pipistrelle, being found not only all over Europe and the temperate regions of Asia, but likewise ranging into Africa north of the Sahara, and also occurring in Java and Sumatra, and entering the confines of British India in Nepal and Sikkim, and not improbably Kandahar.

The noctule differs from the pipistrelle in being a tree-haunting bat and also a gregarious species. In winter its retreat may be either in hollow trees, or under roofs and eaves of houses, in which situations numbers

the cockchafers have become abundant, and you hear them humming on every side, the noctule is in his glory. Then he flies high and straight, and you hear his shrill but clear voice as he passes overhead, interrupting himself to dart at some prey, and then passing on. But an observer will not watch his movements long on such an occasion without noticing a manœuvre which at first looks like the falling of a tumbler pigeon, but on closer observation proves to be simply a closing of the wings, and a consequent drop of about a foot. Sometimes this is repeated every few yards as long as he is in sight. It is occasioned by some large and intractable insect having been captured, and the anterior joint of the wing, with its well-armed thumb, is required to assist in retaining it until masticated."

In Gilbert White's "Natural History of Selborne," it is stated that the noctule is not to be seen on the wing before the end of April, nor later than July.



THE PIPISTRELLE

Other observers, however, have seen this bat in Hampshire and Sussex in August and September, while one instance is on record of its appearance in Cambridgeshire so late as the first week in November.

HAIRY-ARMED BAT

Closely allied to the noctule is the British species known as the hairy-armed bat (*Pipistrellus leisleri*). Its popular name is derived from the presence of a broad band of fine short hairs on the under side of the wing membrane running from the forearm to the wrist. Since, however, this feature is also found in the noctule, it is obviously not distinctive of the species to which it gives the name, and another characteristic must accordingly be found by which to distinguish the two species. Such a characteristic is

found in the incisor teeth. In the hairy-armed bat the outer pair of these teeth in the upper jaw is equal in cross-section at the base to the inner pair, but the height of their crowns is much less; whereas in the noctule the former is much wider at the base than the latter, while it also has the crown hollowed out to receive the summit of the lower tusk, or canine. Then, again, the lower incisor teeth in the hairy-armed bat form a regular semi-circle, with scarcely any overlapping of one over another; whereas in the noctule they have broad crowns, are set obliquely in the jaw, and largely overlap one another. Such characters may seem trivial and unimportant, but they are amply sufficient to prove the specific distinctness of the hairy-armed bat, which



THE NOCTULE

Photographs by Douglas English

may frequently be found together. It appears early in the evening, and its flight is particularly strong and rapid, taking place high in the air. Its favourite food consists of cockchafers and fernchafers, in pursuit of which it may be seen on summer evenings hawking round large trees, especially oaks. An unpleasant odour is characteristic of this bat. "The noctule," writes Professor Thomas Bell, "is essentially adapted for the capture and mastication of coleopterous insects. The broad muzzle and strong jaws are found quite equal to the reduction of the stubborn elytra of beetles as large as the cockchafer, of which he will consume as many as thirteen, one after the other, and the wings are in no way deficient in power when in pursuit of these insects. During the fine midsummer evenings, when

is, moreover, a considerably smaller animal than the noctule, the combined length of the head and body being rather less than $2\frac{1}{2}$ inches. Careful observers will readily discriminate between these bats, even when on the wing, from their difference of habit and mode of flight. "Whilst the noctule," observe the authors of Bell's "British Quadrupeds," "may throughout the whole of the summer be seen taking its regular evening flight, night after night, near the same spot, the hairy-armed bat, on the contrary, will be seen once, perhaps for a few minutes only, and then lost sight of. It appears to affect no particular altitude in its flight, any more than it preserves a regular or prescribed beat.

When the weather is fine, you may see this bat passing on in a kind of zigzag manner, apparently uncertain where to go; generally, though not always, at a considerable elevation, and in a few minutes it is gone." While the long-eared bat and the pipistrelle are all-night fliers, the hairy-armed bat only ventures forth for a short flight in the evening, and again shortly before dawn. The hairy-armed bat

thus enjoys a daily rest of $21\frac{1}{2}$ hours, taking all its exercise and its food in two periods (which in summer may be very close together) of one hour and a quarter each. There is an idea that the noctule indulges only in an evening flight, but additional evidence is required before this can be definitely accepted. Like the noctule, the hairy-armed bat has a wide geographical distribution, ranging throughout Europe and the temperate regions of Asia, and having also been recorded from the Himalaya.

THE SEROTINE

The serotine (*Vespertilio serotinus*) is another large British bat belonging to a group distinguished from the one containing the preceding species by the premolars in the upper jaw being reduced to one on each side. This bat has ears of moderate size, with broadly rounded tips, and the tragus broadest just above the base, and thence gradually diminishing in width to the rounded tip. The general colour of the fur is chestnut brown above, and yellowish grey on the under parts; the hair being long and silky, and the wing membranes dark brown, or nearly black. There is, however, some degree of individual variation in colour, specimens being occasionally found with a greyish tinge to the fur.

The serotine has the widest distribution of any known bat, and is the only representative of the order common to the Eastern and Western hemispheres. Seeing that bats are, from their power of flight, able to traverse with ease long distances over sea, it seems at first sight very remarkable that the serotine is the only species which has succeeded in crossing from the Old to the

New World. It is, however, probable that most bats are unable to withstand the cold of the regions about Bering Strait, where the passage between the two hemispheres is the shortest, and have hence failed to spread themselves in the same manner as the reindeer, elk, and glutton. Modern American naturalists regard the New World serotine as a distinct species, but this does not affect the argument.

The range of the serotine extends from England to Siberia, and from Northern Germany to Northern Africa, whence it is continued through Arabia and Asia Minor to the valleys of the Himalaya. In Africa it is found as far south as the Gabun district on the

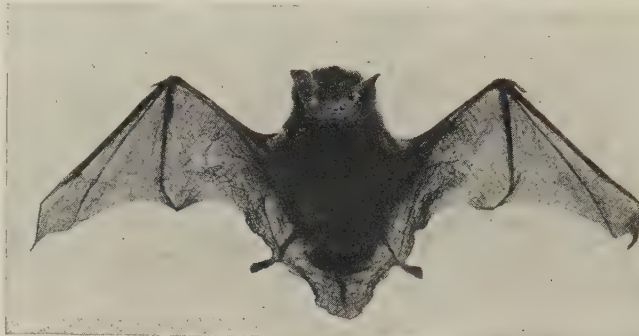
west coast, and it probably extends to the Cameroon Mountains. In America, where it is represented by the race *V. serotinus fuscus*, it appears to be widely spread, from Lake Winnipeg in the north to the Isthmus of Darien, and is met with throughout all the West Indies. The serotine from the Gabun constitutes a third race, distinguished by the fur of the under parts being of pale yellowish white, thus forming a marked

contrast with the dark brown fur of the back.

The serotine, which is a comparatively rare and local species in England, has very similar habits to the noctule, so far as regards the length of its period of hibernation and its consequent late appearance in the spring. It is nearly always found alone, and has a characteristically slow fluttering flight; while, as its name implies, it does not venture forth till late in the evening and, in suitable weather, continues on the wing till dawn. The southern counties appear to be the only part of England in which this bat is found; but in France and other Continental countries it is widely distributed and far from uncommon. In France it may generally be found flying around the tallest trees in forests, and frequents the timber yards in Paris, among the woodstacks of which it conceals itself during the day. In North America it is known as the dusky, or Carolina, bat, the habits of which appear to be very similar to those of the European example.

PARTI-COLOURED BAT

As a common Continental species, reference may be made to the parti-coloured bat (*V. discolor*), which, while belonging to the same group as the serotine, differs in that the widest part of the short tragus is above instead of below the middle. Apart from this, the parti-coloured bat is readily distinguished by the comparative richness of its colouring, which has a somewhat marbled appearance, owing to the light tips of the hairs. Above, the colour of the fur is reddish brown, with the tips of the hairs white; while all the under parts are of a dirty white tint.



HAIRY-ARMED, OR LEISLER'S, BAT



THE SEROTINE

Photograph by Douglas English



THE BANDED MUNGOOSE

This creature is a native of South-Eastern Africa, and derives its popular name from the transverse stripes on the fur of its back.



STRIPED HYÆNAS AND JACKALS AT A FEAST

The striped hyæna—probably on account of its "body-snatching" propensities—is cordially detested by the natives of all the countries it inhabits.



THE WILD CAT, A DENIZEN OF THE SCOTTISH HIGHLANDS

Its fierceness is proverbial, and "several cases are related where wild cats have even attacked human beings.



JAGUAR ATTACKING A TAPIR

The jaguar, the American king of beasts, is able "to pull down and kill animals greatly exceeding itself in size."

HOARY BATS

On the Continent the parti-coloured bat is widely spread, but it is chiefly found in mountain districts; its range extending from Italy and France to Southern Sweden and the Ural Mountains. In Asia it has been observed in Western Siberia and Eastern Turkestan.

SILVER-HAIRED BAT

Mention may now be made of an interesting North American species, known as the silver-haired bat (*Lasionycteris noctivagans*), representative of a genus characterised by having three premolar teeth on each side of the lower jaw, and also by the hairiness of the membrane between the legs. In the upper jaw there are two premolars on each side. The fur above is dark brown, becoming silvery white at the tips in the region of the back; and there is a very characteristic white spot at the base of the brown ears. The silver-haired bat has the most northerly range of any American species, extending to Hudson Bay, and southwards to California. In the Adirondack Mountains, in the State of New York, Dr. Hart Merriam states that it is by far the commonest of all the bats; but whether it remains abroad all night, or limits itself to comparatively brief excursions in evening and early morning, can only be conjectured. He is inclined to favour the latter view, for the reason that the greater number always disappear before the darkness becomes sufficiently intense to hide them from sight.

Before passing on to other forms, it may be mentioned that there are certain bats which differ from all the foregoing in having only a single pair of incisors in the upper jaw. Among them are *Scotophilus schlieferi* of Africa, *S. dormeri* of Southern India, and *Rhogeessa parvula* of Central America.

HOARY BATS

Omitting mention of the genus *Chalinolobus*, which is unknown in Britain, the next representatives of the family Vespertilionidæ are two species of the New World genus *Lasiurus* (often known as *Atalapha*). All these bats have only a single pair of upper incisor teeth; the number of incisors in both jaws being $\frac{1}{2}$, and the cheek teeth either $\frac{5}{5}$ or $\frac{6}{6}$, so that the total number of teeth is thirty-two or thirty. They are also characterised by the membrane between the legs being more or less hairy, and by the expansion and inward curvature of the extremity of the tragus of the ear.

The largest of the more typical species of this genus is the well-known hoary bat (*Lasiurus cinereus*), ranging from Nova Scotia to Chile, and characterised by its ashy grey colour. Dr. Merriam, writing of the habits of this bat in the Adirondack Mountains, observes that it can be recognised, even in the dusk, by its great size, its long and pointed wings, and its swift and irregular flight. The borders of woods, water-courses, and roadways through the forest are among its favourite resorts; and its nightly range is greater than that of any of its associates. While the other species are local, moving to and fro over a very restricted area, this traverses a comparatively large extent of territory in its excursions, probably in consequence of its superior powers of flight.

THE RED BAT

Far commoner in the Adirondacks is the red, or New York, bat (*Lasiurus borealis*), which is of smaller size and conspicuous for its bright golden fur, tipped more or less markedly with silver. This species, which is second only in beauty to the hoary bat, is widely

distributed in North America and represented by several varieties in South America. Dr. Elliott Coues states that "in most portions of the United States the red bat is one of the most abundant, characteristic, and familiar species, being rivalled in these respects by the little brown bat (*Myotis subulatus*) alone. It would be safe to say that in any given instance of a bat entering our rooms of an evening, the chances are a hundred to one of its being one of these two species. The perfect noiselessness and swiftness of its flight, the extraordinary agility with which it evades obstacles—even the most dexterous strokes designed for its capture—and the unwonted shape, associated in popular superstition with the demons of the shades, conspire to produce repulsive feelings that need little fancy to render weird and uncanny."

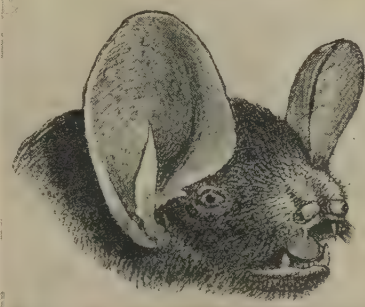
As is the case with many of its North American allies, this bat generally hibernates in large colonies, which select for their retirement a cave or hollow tree.

As an instance of the weight of the young which female bats have sometimes to carry with them, reference may be made to an account by Mr. W. H. Hudson, who states that in La Plata he once captured a female bat which had attached to her breast two young, which were so large that it seemed incredible how she could fly when thus burdened, much less with sufficient speed to catch her insect food. These young ones were fastened on each side of the body of the parent; and when forcibly separated from their hold were incapable of

flight, and fluttered feebly to the ground. The weight of the young in this instance was not, indeed, relatively so great as in the case of the opossum, where seven or eight young may sometimes be seen clinging to the tail and back of the female; but then it must be remembered that the opossum has only to climb, when it can use its claws, teeth, and prehensile tail to aid its movements.

The bat, on the other hand, had to seek its living in the empty air, pursuing its prey with the swiftness of a swallow, "and it seemed wonderful to me," writes Mr. Hudson, "that she should have been able to carry about that great burden with her on one pair of wings and withal to be active enough to supply herself and her young with food. In the end I released her, and saw her fly away among the trees, after which I put back the two young bats in the place I had taken them from, among the thick clustering foliage of a small acacia tree.

"When set free they began to work their way upwards through the leaves and slender twigs in the most adroit manner, catching a twig with their teeth, then embracing a whole cluster of leaves with their wings, just as a person would take up a quantity of loose clothes and hold them tightly by pressing them against the chest. The body would then emerge above the clasped leaves, and a higher twig would be caught by the teeth, and so on successively, until they had got as high as they wished, when they proceeded to hook themselves to a twig and assume the inverted position side by side; after which, one drew in its head and went to sleep, while the other began licking the end of its wing, where my finger and thumb had pressed the delicate membrane. Later in the day I attempted to feed them with some small insects, but they rejected my friendly attentions in the most unmistakable manner, snapping viciously at me every time I approached them. In the evening I stationed myself close to the tree, and presently had the satisfaction of



HEAD OF THE TUBE-NOSED BAT
(After Dobson)

seeing the mother return, flying straight to the spot where I had taken her, and in a few minutes she was away again and over the trees with her twins."

The bats of the genus *Lasiurus*, together with those of the allied American genus *Dasypterus*, are peculiar in having two pairs of mammae, and producing three or four young at a birth. When there are four young, their united weight exceeds that of the parent.

TUBE-NOSED BATS

The production of the nostrils into a pair of tubes has already been noticed as distinctive of a genus of flying foxes (page 304), and it is remarkable to find a like feature reappearing, though in a less marked degree, in a group of insectivorous bats belonging to the Vespertilionidae (pp. 305, 317). These tube-nosed bats, constituting the genus *Harpyiocephalus*, are restricted to North-Western China, India, Ceylon, the Malay Archipelago, and Japan, where they always inhabit hilly districts. They are sufficiently distinguished from all other insect-eating bats by their divergent tube-like nostrils, of which the apertures are circular. But there are other points of difference. The teeth are thirty-four in number, of which there are on each side $\frac{3}{4}$ incisors, a single canine, and $\frac{3}{4}$ cheek teeth; and the upper surface of the membrane between the hind legs bears a thick covering of hair.

The greater number of the species of these bats occurs in Sze-chuen and the Himalaya, some of them also extending into the highlands of India and Ceylon; there is also one from Java and some of the other Malay Islands, and another from Japan. The white-bellied tube-nosed bat (*H. leucogaster*) of the Himalaya is remarkable for its brilliant colouring, the fur being golden orange on the head, the base of the hairs greyish, and on the back pale rufous brown with grey at the base. The fur on the membrane is bright ferruginous, the upper surface of the interfemoral membrane and toes being well covered. Beneath, the fur is white throughout on the chin and throat, the rest of the lower parts having bi-coloured fur—grey at the base with white tips.

Writing of its habits in the North-Western Himalaya, Captain Hutton says that it occurs at an elevation of about 5,500 feet, but does not appear to be common in the hills. An example which flew into a room at night kept low down in its flight, passing under the tables and chairs, as if afraid to emerge into the broad glare of the lamps. This is likewise the mode of flight when searching for insects in the open fields, where it skims closely and somewhat leisurely over the surface of the crops and grass.

MOUSE-EARED BATS

Daubenton's bat (*Myotis daubentoni*) is a well-known, although local, British species, selected as the first example of the genus *Myotis*, which is nearly or quite as numerous in species as *Pipistrellus*. The

bats of this genus have thirty-eight teeth, of which there are $\frac{3}{4}$ incisors and $\frac{3}{4}$ cheek teeth on each side of the jaws. They are easily recognised by the fact that the upper incisor teeth are so implanted as to diverge from one another; and also by the large number of the cheek teeth, which exceeds that obtaining in any insectivorous bats yet noticed, and is only equalled in four other genera, of which three are mentioned later. The second cheek tooth in the upper jaw, belonging to the premolar series, is invariably characterised by its minute size, and the ear has an elongated oval form with its tragus narrow.

The genus is of unusually wide distribution, and found throughout the temperate and tropical regions of both hemispheres. Most of the species are dwellers in woods; some either habitually or occasionally live in caves or under the roofs of houses. The position of attachment of the wings to the hind extremities and the size of the foot appear to be connected with the nature of the dwelling-places, the inhabitants of caves having larger feet more or less free from the membranes, while those living in woods have much smaller feet enclosed in the wing membrane to the base of the toes. The bats of this genus being of a more delicate organisation than the species of *Pipistrellus* are less capable of withstanding the effects of cold, and have therefore a less northerly range than the latter. And in the countries where the bats of the two genera hibernate, those belonging to *Myotis* are later in awakening from their winter slumber than are the pipistrelle and its relatives.

Daubenton's bat belongs to a group of the genus characterised by the large size of the feet, and also by the wing membrane rising, as a rule, from the shinbone or the ankle, as well as by the middle of the free margin of the membrane between the legs forming a very acute angle. The tail has one or two joints

projecting beyond the edge of the membrane last mentioned, and the spur arising from the ankle to support the same is of very great length. The wing membrane extends below the ankle to the metatarsus; and the ears are oval and rather shorter than the head. The length of the head and body is 2 inches, and the span of the wings 9 inches. The fur is brownish black at the base, and usually reddish brown on the upper parts and ashy grey below; although there is considerable individual variation in this respect.

This bat is chiefly characterised, so far as habits are concerned, by its partiality for the neighbourhood of water, and from this peculiarity it is frequently overlooked, even in districts where it is abundant. So closely does it fly to the surface over which it skims, writes Professor Bell, that it is "difficult to distinguish between the creature itself and its reflection. The flight, quivering and slow, is performed by very slight but rapid strokes of the wings. It may, indeed, be said to vibrate rather than fly over the surface of the



GROUP OF DAUBENTON'S BATS

MOUSE-EARED BATS

water. It could not well fly in any other manner so near the surface without often striking it, and this it seldom, or perhaps never, does, although it often pauses to dip its nose into the water, whether to drink or to pick up food we have been unable to ascertain."

Daubenton's bat occurs in England, Scotland, and Ireland, and extends over the greater part of Europe, having been recorded from Finland to Sicily. It is also found in Asia, where it probably ranges over most of the temperate regions to the north of the Himalaya, while to the east of the Bay of Bengal it spreads southwards into Tenasserim. It is sometimes termed the water bat.

ROUGH-LEGGED BAT

The rough-legged bat (*M. dasycneme*) is another species belonging to the same group of the genus, which has been recorded from the southern counties of England. The wing membrane extends only to the ankle; and the species is distinguished from the rest by the form of the tragus of the ear, which approaches that of the serotine, and by the thinness of the hair on the face. It is widely distributed on the Continent, but rare in Britain.

NATTERER'S BAT

The reddish grey, or Natterer's, bat (*M. nattereri*) is also a British species of very local occurrence, and belongs to the second or typical group of the genus *Myotis*. This group is characterised by the smaller size of the foot, by the wing membrane generally extending down the leg as far as the base of the toes, and also by the obtuse angle in the middle of the free hinder margin of the membrane between the legs. The tail is either wholly contained within the margin of that membrane, or has only its extreme tip projecting beyond; while the spur arising from the ankle to support this membrane is shorter, reaching only to half, instead of three-quarters, of the distance between the ankle and tail. The colour of its fur is lighter than that of any other British species. This bat is characterised by the relatively small size of its head, and its fur is of a reddish grey colour above and whitish beneath. Owing to the smallness of the head, the total length of the head and body is somewhat less than in Daubenton's bat, but the span of the expanded wings is 2 inches more, and reaches 11 inches.

In habits it is a sociable species, being found in large numbers in its favourite places of repose, which are generally buildings, especially church towers. The range extends from Ireland to the Urals, and from the south of Sweden to the Alps.

Another closely allied species is Bechstein's bat (*M. bechsteini*), which is limited to Europe, and is of rather larger size than Natterer's; the length of the head and body being 2 inches instead of 1.65 inch. It is distinguished by the hind margin of the membrane between the legs being naked instead of fringed, and also by the shorter tail, of which the length is less than half that of the head and body. The colour is reddish

grey above, and greyish white below. It is very rare in England, but has been taken in the New Forest, and also in Sussex.

WELWITSCH'S BAT

Brief mention may be made of Welwitsch's bat (*M. welwitschi*), from Angola, on the West Coast of Africa, on account of the brilliancy of its colouring. In



NATTERER'S BAT

this bat, which is closely allied to the last species, the head and body are reddish above and straw-coloured beneath, but the naked wing membranes are variegated with orange and black, the dark portions being of a triangular shape, and occupying the spaces between the second and third and third and fourth fingers, and also the space included between the fourth finger and a line drawn between the wrist and the ankle; the remaining portions being orange. The membrane between the legs is margined behind by a black band, and dotted over with small black spots; similar dots also occurring upon the

orange-coloured portions of the wings between the arms and legs. Hodgson's bat (*M. formosus*) of India and China, which is more nearly related to the undermentioned whiskered bat, has an almost identical colouring, the main difference being that the membrane between the legs is wholly orange, and the black spots are wanting from the orange areas of the wings; while orange flecks occur on the black species.

While on the subject of brilliantly coloured bats, mention may be made of two other species belonging to different genera. One of these is the Indian painted, or plantain, bat (*Cerivoula picta*), belonging to a genus closely allied to *Myotis*, but distinguished by having the upper incisor teeth parallel instead of divergent. In this bat the fur on the upper parts is a deep orange or ferruginous red, and that beneath paler. The wing membranes are black, with orange spots and lines of orange along the fingers and on the margins, while the membrane between the legs is wholly orange. So brilliant is the species that it is said to have the appearance of a gorgeous butterfly rather than a bat.

Our second example of contrasting coloration is the white-winged bat (*Scotophilus albobfuscus*), from the River Gambia, on the West Coast of Africa. The genus *Pipistrellus*, which has been mentioned on page 310, is closely related to *Scotophilus*. In colour the body of the white-winged bat is dark umber brown both above and below; and the naked skin of all the portions exposed when the creature is at rest is likewise of a nearly similar hue. On the other hand, those portions of the wing membranes lying external to a line drawn from the elbow to the knee are pure white on both sides, thus contrasting very markedly with the dark tint of the body and limbs. All the other known members of the genus have the body and wings more or less uniformly coloured; but many of the smaller bats of the Gambia, belonging to several distinct genera, have dark bodies with white wings. That there is good reason for this peculiar style of



THE MURINE BAT

colouring among Gambian bats is evident, although no explanation has hitherto been offered. With regard to the colouring of Hodgson's bat, it has been shown that in the island of Formosa this species is in the habit of hanging suspended on the boughs of the longan tree (*Nephelium*). This tree is an evergreen, and all the year through some portion of its foliage is undergoing decay, the particular leaves being, in such a stage, partially orange and black. The bat can, therefore, at all seasons suspend itself from its branches, and elude its enemies by its resemblance to the leaf of the tree. When the fruit is ripe and reddish yellow, the bats try to escape observation by means of the resemblance of their own tints to those of the fruit. A similar explanation will doubtless hold good with regard to the Indian plantain bat; the plantains, on which it feeds, being, when ripe, of a bright yellow or orange colour, speckled with black, and thus almost exactly similar to the bat.

THE WHISKERED BAT

The last member of this group to be mentioned here is the whiskered bat (*M. mystacinus*), which, while agreeing in the relative size of the feet and other leading characters with Natterer's bat, belongs to a subgroup distinguished by the tragus being straight and more or less blunted at the tip, instead of acutely pointed and inclining outwards. This bat is of small size, the length of the head and body being only $1\frac{1}{2}$ inch, and the spread of the outstretched wings $8\frac{1}{2}$ inches. The fur on the upper part of the body is dark chestnut, tending to black, and dusky beneath. It takes its name from the fringe of long, fine hair on the upper lip, and is a solitary species, although on some occasions a considerable number may be seen together on account of the abundance of food in particular localities. In its mode of flight and general habits it is very similar to the pipistrelle, hiding during the day in situations as various as are those favoured by different individuals of that species. Its range embraces the greater part of Europe, inclusive of the British Isles, where it is rare; while in Asia it has been found in Syria, the Himalaya, and North China.

SCHREIBERS' BAT

As a well-known Continental species, representing another genus, brief mention may be made of Schreibers' bat (*Miniopterus schreibersi*), the range of which

extends from Germany to Japan and Australia. It differs from all the preceding forms in the great elevation of the crown of the head above the face. The same feature is found in the South American and West Indian tall-crowned bats (*Natalus*). Both these bats are distinguished by the presence of a gap in the middle line between the first pair of incisor teeth, and by a second gap between the second incisor and the tusk. The American tall-crowned bats, while agreeing with *Myotis* in the number of their teeth, are further distinguished by the small size of the tragus of the ear. On the other hand, Schreibers' bat has but thirty-six teeth, owing to the absence of the first pair of premolars.

SUCKER-FOOTED BATS

The account of the typical bats may conclude with a brief reference to two remarkable genera, each represented only by a single species, and peculiar in having sucking organs on the thumbs or hind feet. One of these species is the tricolor bat (*Thyroptera tricolor*) of Brazil, and the other the golden bat (*Myzopoda aurita*) of Madagascar. Both have thirty-eight teeth, as in the genus *Myotis*. In the former the suckers on the extremities are in the form of round discs on the lower surfaces of the thumbs and the soles of the feet; while in the latter the sucker on the thumb is horseshoe-like, and those on the feet are smaller. Both bats are further remarkable for possessing three joints in the third or middle finger of the wing, in which respect they resemble the family of free-tailed bats. By the aid of their adhesive foot discs these bats are enabled to climb smooth polished surfaces. The occurrence of the two forms in such widely remote regions as Madagascar and Brazil might be taken to indicate a connection between the faunas of South Africa and South America, but these two bats do not appear to be nearly related; and the sucking apparatus has probably been developed independently (page 321).



SCHREIBERS' BAT

THE FREE-TAILED BATS

THE remaining members of the order are characterised by the fact that, as a rule, the tail, when present, either penetrates the membrane between the legs, so that its extremity appears on the upper surface, or is produced considerably beyond the hind margin; secondly, by the fact that the innermost, and frequently the only, pair of upper incisor teeth are generally of large size, and placed very close together; and, thirdly, by the fact that, except in two genera, the first joint of the third or middle finger of the wing is, when at rest, folded back upon the upper surface of its supporting metacarpal, instead of being extended forward in the same line, as in the species hitherto described. No representative is found in the British Isles, and only one within the European area.

These bats are mainly characteristic of tropical and sub-tropical regions; but while the first of the two families into which they are divided ranges over both hemispheres, the second is strictly confined to the central and southern portions of the Western hemisphere. The number of genera, to say nothing of species, is very large, but only a few typical forms of interest from peculiarities of structure or of habits need concern us here.

The first of the two families, namely, the Emballonuridae, occupies a position somewhat similar to that held by the typical bats. In addition to the peculiar mode of folding the third finger of the wing, and the characters of the tail, these bats are distinguished by the fact that there are but two bony joints in this third finger, and also by the absence of any distinct nose-leaf. As a rule, they have a small tragus in the ear, and only a single pair of upper incisor teeth, which incline towards one another. The extremity of the snout is obliquely truncated from above downwards, so as to cause the nostrils to project more or less in front of the tip of the lower jaw. The family includes one of the two species which are the only representatives of the entire order (as they are of the whole class of mammals) found in New Zealand; but the range on each side is mainly restricted to the belt lying within thirty degrees of the Equator.

SHEATH-TAILED BATS

The mountain bat (*Emballonura monticola*) is a representative of a group of the typical genus of this family, which may be collectively known as sheath-tailed bats, and in which the tail is slender, with its free extremity perforating the membrane between the hind legs, while the legs are relatively long, and the upper incisor teeth comparatively small and weak. The special characteristic of the genus is the presence of two pairs of upper incisor teeth; the total number of teeth being thirty-four, of which $\frac{2}{3}$ on each side belong to the incisor, and $\frac{1}{3}$ to the cheek series. The production of the muzzle is more or less strongly marked, the top of the head is flat, and the ears are not united, and have a tragus of somewhat oblong form, and expanded above.

The mountain bat, which is of a chocolate brown colour, and measures about $1\frac{1}{2}$ inch in length, exclusive of the tail, is a native of Java, Sumatra, Borneo, and the Philippines; the other representatives of the genus inhabiting various islands in the region extending from Madagascar to the Navigator group. The genus is, therefore, exclusively insular, and, in this respect, quite peculiar. The Polynesian sheath-tailed bat (*E. semicaudata*) is found in the Mergui Archipelago.

POUCH-WINGED BATS

The remarkable pouch-winged bats (*Saccopteryx*) of Central and South America do not generally exceed a couple of inches in length, and have fewer teeth than

the foregoing; the number of incisors being $\frac{1}{3}$, and the cheek teeth $\frac{5}{5}$ on each side. They derive their name from the presence of a peculiar glandular pouch on the under side of each wing, at or near the elbow joint. These pouches, which are well developed in the males but rudimentary in the females, secrete a red-coloured strongly smelling substance which appears to act as a sexual attraction. In one species from British Guiana (*S. leptura*) these pouches are unusually large, and from each of them projects a prominent white frill of skin, which seems capable of being protruded and withdrawn at the will of the animal; the use of this is unknown. In Demerara these bats may be seen flying about close to the houses at dusk. Professor Moseley relates that he caught an example of another species (*S. canina*) in Bahia resting fast asleep on the bare bark



TRICOLOR BAT

of a large tree; the dense forest growth overhead making such an exposed situation dark enough for a resting-place throughout the day. Nearly all the species have the fur of a uniform dark brown colour, although one displays a reddish tinge.

TOMB BATS

The bats of the genus *Taphozous* derive both their popular and scientific titles from the fact that one of the species is found in vast numbers in the ancient Egyptian tombs. Tomb bats differ from other members of the group in having only two pairs of incisor teeth in the lower jaw, and also in the circumstance that the upper pair of these teeth is shed in the adult state. Instead of the glandular pouches on the wings characteristic of the preceding genus, most of these bats have pouches of a similar nature on the under surface of the skin; these being chiefly, and in some cases exclusively, developed in the male sex. Many individuals, especially those taken during the hibernating season, have large deposits of fat around the root of the tail and the base of the thighs, probably for supporting life during the winter sleep, which, from the more northerly range of this species, would appear to be longer than among the other representatives of the genus.

The tomb bats are found in Africa, India, Burma, the Malay region, and Australia, but are unknown in Polynesia. Most of them are dwellers in caves, fissures in rocks, and old buildings; but one Indian species has been observed on the stem of a palm tree. One of the best-known species is the naked-bellied tomb bat

(*Taphozous nudiventris*), readily recognised by its tawny fur and the bare under parts. It is a large species, measuring $3\frac{3}{4}$ inches in length, exclusive of the tail, the span of the wing being about 20 inches. This species is widely distributed over Africa, and is the one found in the Egyptian tombs, while it also extends into Syria and Palestine. The caves near the Sea of Galilee are inhabited by clouds of these bats. Writing of the Sumatran species (*T. affinis*), Mr. E. C. Buxton states that at Telok Betong, in Sumatra, "there was an old, hollow coco-nut stump in the garden, and about twenty of these bats lived in it. At night, or rather early in the morning, they used to hang at the top of the veranda in company with several other kinds; and I found that they were all fruit-eaters, as there was a great deal of fruit refuse under them." The tail of the tomb bats perforates the membrane between the legs near its centre, and thus has the tip freely projecting. At the will of the animal, however, it can be withdrawn almost completely within the membrane, which thus forms a kind of sheath.

WHITE BATS

As white is rarely met with among the bats, special attention may be directed to the white bats, represented by two species from Central and South America. These bats are allied to the tomb bats, but have three pairs of lower incisor teeth, and are also distinguished from other bats by the presence of a peculiar pouch on the under side of the membrane between the legs. The typical white bat (*Didelphus albus*) has the fur on the body dark at the base, but the greater portion of each hair up to the tip is of a yellowish or creamy white, while the whole of the wing membrane is pure white. The first known specimen was found in Brazil reposing between the leaves of a coco-nut palm. If this be the normal habitat of the species, its colouring may perhaps be a protective one, adapted to resemble the silvery hue of the under surface of the palm leaves. Albino varieties of dark-coloured bats are occasionally met with; a white specimen of the Cape pipistrelle (*Pipistrellus capensis*), for example, was obtained in 1890 near Cape Town.

HARE-LIPPED BATS

If the white bats are noteworthy on account of their colour, the few species of hare-lipped bats (genus *Noctilio*), which are likewise Central and South American, are deserving of mention on account of the curious superficial resemblances of their muzzles to those of the rodents, while at least the ordinary species (*Noctilio leporinus*), which has been known since the time of Linnaeus, is not less remarkable from the

peculiar nature of its diet. These bats derive their ordinary name from the curiously folded upper lip, which is bent upwards in the middle line in the form of an inverted V, terminated above by the nostrils. The feet and claws are remarkable for their large size. Hare-lipped bats have twenty-eight teeth, of which there are $\frac{2}{3}$ incisors, and $\frac{1}{3}$ cheek teeth on each side. The first or innermost pair of upper incisor teeth are of



HEAD OF THE TOMB BAT

great size, and placed close together so as to conceal the small outer pair; and as the larger ones bite against the single smaller pair of lower incisors, the resemblance to the mouth of a small rodent is striking.

These bats are almost omnivorous in their diet. That they would freely eat cockroaches was proved by Gosse, when in Jamaica; and it was at the same time shown that they would chew, although not swallow, the flesh of small birds. In 1859 Mr. Fraser, writing from Ecuador, stated that they had a very peculiar and offensive fishy smell, and that he had observed them skimming the bank of a river, every now and then making a dash and striking the water, catching tiny shrimps as they passed up stream. Later investigations clearly established the fact of their fish-eating habits.

LONG-TAILED BAT

The long-tailed bat (*Rhinopoma microphyllum*) is found from North-East Africa, through India, to Burma. It has twenty-eight teeth, of which $\frac{1}{2}$ on each side belong to the incisor, and $\frac{1}{4}$ to the cheek series. Its most distinctive feature, however, is the long and slender free tail, which projects far beyond the margin of the very short membrane between the legs, thereby distinguishing the



LONG-TAILED BATS

creature at a glance from all other bats. It is further peculiar in that the second, or index, finger of the wing has two joints. Another feature of less import, although the one which has given the scientific name to the genus, is the presence of a fleshy prominence on the muzzle, just over the nose; this prominence having been incorrectly regarded as a rudimentary nose-leaf. In specimens taken in India during the cold season there is an enormous accumulation of fat around the tail and thighs, which may be so large as to exceed the weight of the rest of the body; the accumulation being similar to that in the naked-bellied tomb bat and doubtless serving the same purpose.

lation being similar to that in the naked-bellied tomb bat and doubtless serving the same purpose.

MASTIFF BATS

The so-called mastiff bats, of the genus *Molossus*, which take their name from a supposed resemblance of their broad, wide-mouthed muzzles to the head of a mastiff, are characterised by the thickness of their tails; these, with a single exception, being prolonged for a

MASTIFF BATS

considerable distance beyond the hind margin of the membrane between the hind legs. The legs are short and strong, and the feet of great relative width; the thumbs of the wings have curious callosities at their bases; and the upper incisor teeth are of large size, and limited to a single pair. The feet are free from the wing membranes, which can be folded up and stowed away between the forearms and the legs, and the membranes between the legs can be retracted to a greater or less extent by being moved backwards and forwards along the tail. In the strength of their limbs, in the development of the corn-like callosities on the bases of their thumbs, as well as in their large and flat feet and the freedom of their feet from the wing membranes, the mastiff bats and their allies appear more adapted for crawling on the ground than any other members of this group of animals; and the result of observations on living specimens has been to confirm this inference.

The mastiff bats are an American group, found in the tropical and subtropical regions of both divisions of the Western hemisphere. With the exception of two species in which the number of the lower incisor teeth is reduced to a single pair, they have either twenty-six or twenty-eight teeth, of which $\frac{1}{2}$ on each side are incisors, while the cheek teeth number either $\frac{4}{4}$ or $\frac{5}{4}$. The upper incisors are placed close together in the middle line; and the large ears, which have a small tragus (occasionally absent), are united by their inner margins. In common with two nearly allied genera, they have very capacious lips, which in most of the species are thrown into a number of wrinkles or puckers, and they are further characterised by their long and slender wings. The great length and narrowness of the wings indicate rapid flight, and since they also possess the power of varying the length of the membrane between the legs by a "reefing" process, they display marked dexterity in suddenly changing their direction, as when they are compelled to double in pursuing swiftly flying insects; and as their expansive and capacious lips aid the teeth in seizing and retaining the round and solidly armoured bodies of the larger beetles, it would seem that they are better adapted than any other members of the order for capturing insects of very swift flight.

The red mastiff bat (*Molossus rufus*) inhabits the roofs of houses and the hollow trunks of palm trees, where colonies of large size may sometimes be found. It is more active when on the ground than any other species; and, indeed, on such occasions its movements are so rapid that some agility is required to ensure its capture. In the act of running it rests on its wrists, with the fore part of the body considerably raised. In the hollow stem of a palm tree examined by an observer it was found that while

in one place the males of this species were collected to a number approaching two hundred, in another spot the assemblage consisted almost entirely of females, with only a male here and there. This distinction of the resting-places of the two sexes has also been noticed in certain other bats.

In describing the habits of another species, the chestnut mastiff bat (*M. glaucinus*), Gosse observes

that "soon after sunset we hear the scrambling of little claws along the plaster [in the loft above] gradually tending towards the point where the hole under the eaves is situated. I judge that they crawl along one after another in a straight line to the outlet, in parties. They return between eight and nine o'clock, and issue forth again before the morning twilight. When



THE MASTIFF BAT

handled, impatience of detention is manifested by a continuous screeching, not very loud, but exceedingly harsh and shrill. The ears are commonly so pendent as completely to cover the eyes; but they are occasionally retracted so as to expose the eyes, especially if the face be touched."

In certain parts of the Amazon valley the mastiff bats, along with some species belonging to the vampire family, are so numerous as to become a serious inconvenience to travellers. When at Caripe, a station situated about twenty miles from Para, Bates narrates how the first few nights of his stay he slept in a room with the roof open to the tiles and rafters, which had not been used for months before, and on the second night of his visit was awakened towards midnight by the sudden rushing of bats from all quarters. He was so pestered by swarms of the creatures flying around, and even biting him as he lay in his hammock, that at last he had forcibly to eject the unwelcome visitors.



HEAD OF THE MASTIFF BAT

Many were shot as they clung to the rafters, while the negroes ascended the roof from outside by means of ladders, and succeeded in routing out hundreds of them from beneath the eaves, among which were several broods of young ones. Although there were altogether four species of bats present on this occasion, one of which belonged to the genus *Phyllostoma*, another to *Glossophaga*, and two to the present genus, by far the greater number pertained to the large-eared mastiff bat (*M. perotis*), characterised by the great size of its ears, and having a span of wing of two feet. It was these bats which crawled over

Bates in his hammock; but it was the *Phyllostoma* that appears to have inflicted the wound.

NAKED BAT

One of the ugliest and weirdest of all the bats is the naked, or collared, bat (*Chiromyotis torquata*), of the Malay region, which is a large species, measuring $5\frac{1}{4}$ inches in length, exclusive of the tail. The total number of its teeth is twenty-six, of which

$\frac{1}{2}$ are incisors, and $\frac{4}{5}$ cheek teeth on each side. With the exception of a collar of thinly spread hairs nearly surrounding the neck, the thick and puckered skin is almost completely naked. The great toe is longer than all the others, to which it can be opposed; the ears are not joined together, the lips are smooth, and the tail is very long and thick, with more than half its length freely projecting beyond the hind border of the membrane between the legs.

The most curious feature about this repulsive-looking bat, in which the muzzle is long and pig-like, however, is the presence of a deep pouch on the under side of the body below the armpits. These pouches, which occur in both sexes, are for the purpose of containing the young during the period of suckling; and are absolutely necessary, since in their absence the young would be quite unable to cling to the naked body of the parent. Since these pouches are present in the males as well as the females, it has been suggested that in cases where there are twins the male parent may relieve his mate of the task of carrying one of the offspring; instances of a similar division of labour are believed to occur among the flying foxes.

This bat occurs in the larger islands, such as Java, Sumatra, and Borneo, of the Malay region, where it dwells in the heart of the densest forests. During the day its place of repose may be a hollow tree, or cleft in the rocks, or hole in the ground. Its heavy and slow flight begins as soon as the sun reaches the horizon, and takes place in the openings and glades of the forests, or even high up in the air in the open plains.

WRINKLED-LIPPED BATS

By far the most abundant in species of the bats of this group, as well as the most widely spread, are the wrinkled-lipped bats of the warmer regions of the genus *Nyctinomus*. While closely allied to the mastiff bats, they are distinguished by the upper incisor teeth being separated from one another in the middle line, and also by the much greater development of the vertical wrinkles on the capacious lips. The ears are generally more or less extensively united at their bases, and the number of teeth varies from thirty-two to twenty-eight. One member of the genus, Ceston's bat (*Nyctinomus cestoni*), is the solitary representative of the whole family found in Europe, where it extends as far northwards as Switzerland. This species measures nearly $3\frac{1}{2}$ inches in length, exclusive of the tail, but most of the others are smaller. Ceston's bat has the peculiar power of being able to sink its eye within the socket, and then to protrude it again. It has, perhaps, the widest range of all the species, occurring not only in the south of Europe, but also in Egypt, Nubia, Amoy, and China.

Mr. Swinhoe observes that "the creature has a habit of exposing its tail, and of sinking its eye into the socket and thrusting it out again. The membrane extending from the tail to the legs is wrinkled, and covers the tail like a glove, so as to slip up and down as the creature wishes to expand or contract its interfemoral wing; or, in nautical language, to shake out or take in reefs." The tail cannot be completely withdrawn into the membrane, after the manner of that of the tomb bats.

Two species are found in India, two in Australia and New Guinea, and others in America; but the majority

are restricted to Africa south of the Sahara and Madagascar. The Indian species are generally found during the day in caverns and old buildings, countless myriads inhabiting the limestone caves of Phagat, thirty miles from Moulmein, in Burma; and it is probable that the habits of most of the species are similar.

Writing from Jamaica of the habits of the Brazilian wrinkled-lipped species (*N. brasiliensis*), Mr. W. Osborn observes: "Vast numbers of these little bats inhabit the shingled roof of my house. I counted fourteen little heads in a mass about the size of a turnip. But

they are not all asleep; now and then a wing is stretched out with drowsy enjoyment; and the luxury which King James thought too great for subjects and which ought to be reserved for kings is largely indulged in by these bats. First one and then another wakes up, and withdrawing one leg, and leaving himself suspended by the other alone, adroitly uses the foot at liberty as a comb, with a rapid, effective movement dressing the fur of the under parts and head—an action far from ungraceful. The foot is then cleaned quickly with the teeth or tongue, and restored to its first use. Then the other leg does duty. Perhaps the hairs with which the foot is set may aid to

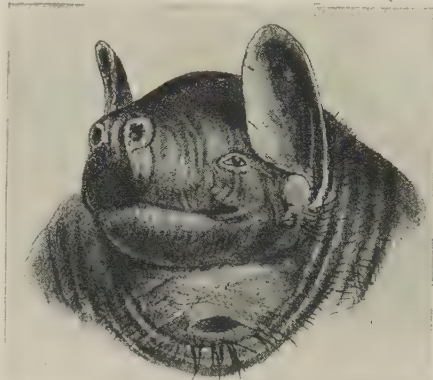
this end. I often have seen them do this in confinement, and probably the numerous bat-flies with which they are infested may be the cause of extra dressing."

NEW ZEALAND BAT

That New Zealand, with a climate which is very much more favourable to these animals than are the meteorological conditions of the British Isles, should possess only two species of bats is a very remarkable fact. One of these (*Chalinolobus tuberculatus*), belonging to a genus closely allied to *Pipistrellus*, is common to New Zealand and Australia; while the second (*Mystacops tuberculatus*) is peculiar to the former country, and represents a distinct and aberrant group of the family under consideration.

The New Zealand bat (*Mystacops tuberculatus*) differs from the other members of the family Emballonuridae in that the third, or middle, finger of the wing is provided with three distinct bony joints; of which the first, when at rest, is folded back beneath, instead of above, its supporting metacarpal bone. Moreover, while the greater part of the wing membranes is very thin, the portion along the sides of the body and the lower moieties of the limbs is much thickened; beneath this thickened portion the remaining parts of the wings lie folded away as if in a case, and in that condition this species is better adapted to indulge in a crawling or climbing life than any other member of the order. There are other peculiarities that are adapted to aid in climbing, and these are connected with the thumb, feet, and legs. The length of the head and body is $2\frac{1}{2}$ inches, and the general colour of the upper parts is brown, though beneath it is paler. Even the fur of this bat can, under the microscope, be distinguished from that of all other species; the individual hairs being very thick, and with only faint traces of the projecting scales characteristic of other bats. The tail is extremely short.

From its structural peculiarities Dr. Dobson surmised that this bat hunted for its insect food not only in the air, but also on the branches and leaves of trees, among which it is able to creep with ease.



HEAD OF FEMALE NAKED BAT

THE VAMPIRE BATS

THE extensive group which it is convenient to allude to collectively under the name of vampires (family *Phyllostomatidae*) is exclusively confined to Central and South America and the West Indian Islands. While related to the preceding family, with which they agree in the characteristics mentioned on p. 321, they differ in certain other points of importance. It has been held that they present a relationship to the smooth-nosed free-tailed bats similar to that presented by the leaf-nosed bats to the typical bats, but this is not accepted by all naturalists.

Vampires are characterised by the presence of three bony joints in the third, or middle, finger of the wing, accompanied either by a well-developed nose-leaf, or by folds of skin and warts on the chin. Such of them as have a nose-leaf—and these are by far the great majority—may be always distinguished from the leaf-nosed and horseshoe bats, not only by the number of joints in the third finger and by the characters mentioned on p. 321, but by the presence of a distinct tragus to the moderate-sized ears. As regards the skull, it will be found that while in the leaf-nosed bats and their allies the premaxillary bones, in which the one pair of small upper incisor teeth is implanted, are small, separate, and loosely attached to the skull, in the vampires these bones are large, firmly united both to one another and the skull, and generally carry two pairs of large incisor teeth.

The number of genera and species of vampires is so great that only the more remarkable types need be considered here. With the exception of a few species which have well-developed tails and a large membrane between the hind legs, and which are of strictly insectivorous habits, the vampires are remarkable for the varied nature of their food, some subsisting on a mixed diet of insects and fruits, others being wholly frugivorous, and a few exclusively blood-suckers.

Others, again, although there has been and still is considerable doubt on the matter, appear to vary their ordinary diet by resorting to blood-sucking when occasion offers. All are of purely aerial habits, and present none of the adaptations for crawling which characterise the mastiff bats and their allies. They appear to be limited to the forest-clad districts of the regions they inhabit, and do not probably extend much farther south than the thirtieth parallel of latitude. That they are a highly specialised family is apparent both from their structure and the peculiar habits of many of their representatives. In South America the name vampire is applied indifferently to several members of the family—a circumstance which has been a fruitful source of confusion.

CHIN-LEAFED BATS

Two genera, each containing a considerable number of species, differ from the other members of this family in the absence of a nose-leaf, the function of which is performed by folds or lappets of skin depending from the chin. These bats may consequently be called chin-leafed bats. They are of small size, the largest only measuring $2\frac{1}{2}$ inches in length, exclusive of the tail. All the species of the genus *Mormops* are distinguished from those included in the genus *Chilonycteris* by the great elevation of the crown of the head above the line of the face. While most of the species are dull-coloured, Blainville's bat (*Mormops*

blainvillei) is remarkable for the bright orange hue of its fur, and for its extremely fragile structure, the head being so delicately formed that light can actually be seen through the roof of the open mouth.

TYPICAL VAMPIRES

As an example of the species furnished with a nose-leaf, the well-known great vampire (*Vampirus spectrum*) may be cited, this species belonging to a group of the family in which the tail, when present, perforates the membrane between the legs (p. 326). The nose-leaf, as in most members of the family, is spear-shaped, whence the name of spear-nosed bats, frequently applied to all the vampires. The great vampire, which is abundant in many parts of the valley of the Amazon, such as the neighbourhood of Ega, is the largest of all the South American species, measuring 28 inches in expanse of wing. "Nothing in animal physiognomy," observes Bates, "can be more hideous than the countenance of this creature when viewed from the front, the large, leathery ears standing out from the sides and top of the head, the erect, spear-shaped appendage on the tip of the nose, the grin, and the glistening black eye, all combining to make up a figure that reminds one of some mocking imp of fable.

No wonder that some imaginative people have inferred diabolical instincts on the part of so ugly an animal. The vampire is, however, the most harmless of all bats, and its inoffensive character is well known to residents on the Amazon. I found two distinct species of it, one having the fur of a blackish colour (*V. auritus*), the other of a ruddy hue (*V. spectrum*), and ascertained that both fed chiefly on fruits."

While the great vampire is without a tail, the lesser vampire (*V. auritus*) has a small rudiment of that appendage (p. 327). The latter species serves to connect the former with the members of the allied genus *Lophostoma*, in which the nose-leaf is narrower in front, and the chin has a central naked space marked by small warts. It also shows resemblances to the javelin bats in the presence of a glandular opening near the top of the breastbone.



HEAD OF BLAINVILLE'S CHIN-LEAFED BAT

JAVELIN VAMPIRES

The javelin vampires (*Phyllostoma*) are distinguished from typical vampires by the shorter and broader muzzle, and the presence of two (instead of three) premolar teeth

on each side of the lower jaw. The common javelin vampire (*Phyllostoma hastatum*) measures just under 4 inches in the length of head and body, and is next in point of size to the great vampire. Its general colour is usually dark greyish or reddish brown above, and paler beneath, but sometimes the upper parts are of a brilliant chestnut brown. Two other species are much smaller, measuring only 3 inches, or a fraction more, in length of head and body. All are found in Brazil, and they generally rest in the trunks of hollow trees or beneath the leaves of palms. They have been credited with blood-sucking propensities, and evidence indicates that the indictment is likely to be true. Mention has been made of Bates's account of his being wounded during the night by a bat which he refers to this genus; and that naturalist further observes that "the fact of their sucking the blood of persons sleeping, from wounds which they make in the toes, is now well established; but it is only a few persons who are subject to this blood-letting. According



THE GREAT VAMPIRE BAT

to the natives, the *Phyllostoma* is the only kind which attacks man." The latter part of the statement makes this testimony the less convincing, since there is no doubt that the blood-sucking vampires, mentioned on the next page, are the species which most generally and habitually attack mammals. The bat caught by Bates was a javelin bat, or an allied form, because he noted the large size of the nose-leaf; and thus the only way in which his statement could be disproved would be by assuming that, while a true blood-sucking vampire was the real culprit, the javelin bat was the one caught and charged with the attack.

Dr. A. R. Wallace's testimony, as given in "Travels on the Amazons," is very similar to that of Bates; the javelin bats being here also the ones accused of blood-sucking. In "Tropical Nature," Dr. Wallace, indeed, mentions the bats charged with this crime as having their tongues armed at the tip with horny papillæ, which would seem to point to the long-tongued vampires, the food of which is insects and fruit. He alludes, however, in both places to the blood-sucking bats as javelin bats; and although there is evidently some confusion in regard to the tongue, it is difficult to believe that two independent observers should have been so deceived as to charge members of one group of bats with an attack committed by those of another.

LONG-TONGUED VAMPIRES

A group of several genera of rather small or medium-sized bats is distinguished from the other members of the present family by their long and narrow muzzles, and slender, elongated tongues, which can be protruded for a considerable distance beyond the mouth (p. 328). At their extremities these tongues are armed on the upper surface with a number of long, thread-like papillæ, which, it was long considered, were employed for abrading the skin of animals before the process of blood-sucking. It now appears, however, that their use is either to extract the soft pulp from the interior of hard-rind fruits, or to lick out insects from the tubes of flowers. That some of the species feed on fruits has been ascertained by direct observation; but the discovery of the remains of insects in the stomachs of others proves that the diet of all is not alike. One of the species

which feeds on insects is the shrew-like vampire (*Glossophaga soricina*), and since this species has a well-developed membrane between the hind legs, while in some of those subsisting entirely on fruits the same membrane is very short, it has been suggested that the nature of the food of any given species may be inferred from the relative size of this membrane. The species with the longest tail membrane will be the best flyers, and consequently those best suited for the capture of insects.

Writing of Sezekorn's vampire (*Phyllonycteris sezekorni*), of which some individuals were taken from a large colony in a cave in Jamaica, Mr. Osburn describes their mode of feeding on the fruit of the so-called clammy cherry: "The tongue was rapidly protruded and drawn in again, and the juice and softer pulp cleared away with great rapidity. I noticed the bat was very particular in clearing out the bits of loose skin of the berry, and licked my fingers clean of the juice spilt on them, cleaning out any that had collected under the nail. I then got another berry. The bat was hanging against the edge of the box, its under

surface against the side; and as I held the berry a little distance off to see the action of the tongue, it had, whilst feeding, to bend the neck so as to raise the head a little; this seemed to fatigue it. It therefore raised itself on one wrist, and turned round so that its back was against the box's side; but as it did not change the position of the feet, of course the legs crossed, the right foot now being on the left side, and *vice versa*. In this odd position it appeared perfectly at ease, and went on licking at a fresh berry with great relish. As the pulp and juice became exhausted I expected the bat would drop it, and was prepared with another berry; but, to my surprise, he brought up the wrists to the muzzle, took the berry between them, gave it two or three energetic bites, and then held the berry off. So now I understood what the unusually long thumbs were for; for they applied themselves dexterously to the berry, held it firmly, and then, as it appeared to me, by a reverse action of the two wrists the berry was turned round, a fresh hold taken by the teeth, and the same licking process renewed till the seed in the centre was cleaned of the pulp, all but the little bit which served for the last tooth-hold. It was then dropped, and the eager little muzzle raised for more."

SHORT-NOSED VAMPIRES

The short-nosed vampires comprise a group of several genera, all the members of which are mainly of frugivorous habits. These bats may be easily recognised by their very short and generally wide muzzles, furnished with a short nose-leaf, of which the front portion is horseshoe-shaped, and the hind part spear-like. The membrane between the hind legs has its free margin excavated to form a hollow curve, and there is no trace of a tail. Two of the best-known species are *Artibeus planirostris* and *A. perspillatus*, the former of which was regarded by Charles Waterton as the veritable blood-sucking vampire. The latter is abundant in the caves of Jamaica, and feeds on bread-nut, mangoes, and other fruits; it measures $3\frac{1}{2}$ inches in length, and, with its allies, may be considered in South America to take the place of the flying foxes of the Old World. These bats fly early in the evening, and repose during the day in places exposed to some amount of light, having been observed beneath the eaves of a house in Demerara

with the rays of the setting sun shining full on them. In other places they have been found roosting in large clusters beneath the fronds of the coco-nut palm. Of another Jamaica species (*Stenoderma achradophilum*) Philip Henry Gosse remarked that it feeds on the fruit of the naseberry, fragments of which, of considerable size, partly eaten by a bat, are frequently found at the distance of half a mile from the nearest naseberry tree. The centurion bat (*Centurio senex*) differs from all the members of this group in the absence of a distinct nose-leaf. Owing to the remarkable foldings of the skin, the face presents a most grotesque appearance (page 328).

BLOOD-SUCKING VAMPIRES

The three species of blood-sucking vampires, representing two genera (*Desmodus* and *Diphylla*), present the following characteristics: Firstly, they may be recognised by their very short and conical muzzles, surmounted by a small though distinct nose-leaf; as well as by the shortness of the membrane between the hind legs, and by the total absence of a tail. Secondly, they are characterised by the small number and peculiar structure of their teeth; these being reduced to twenty in one species and twenty-four in the other. In the genus *Desmodus* there are no molar teeth, although a small rudimentary one is present on each side of the jaws of *Diphylla*. In the upper jaw there is a single pair of very broad-crowned incisors, which fill up the whole of the space between the tusks, or canines, and have keen and sharp cutting edges like chisels. The pre-molar teeth, of which there are two pairs in the upper and three in the lower jaw, have likewise trenchant cutting edges working against one another, and being quite unlike those of any other bat. When to these characteristics are added the sharp tusks with which each jaw is provided, it will be evident that the teeth of the blood-sucking vampires must be specially adapted for some particular purpose—that purpose being blood-letting.

It is not, however, by any means only in their teeth that these bats are adapted to their mode of sustenance, the structural modification also extending to their internal organs. In other bats, for instance, the stomach has the usual subglobular form common to mammals in general; but in the blood-sucking vampires it becomes an elongated organ of a tube-like form; blood naturally requiring little or no process of digestion before being absorbed into the tissues of the animal by which it has been swallowed.

The common blood-sucking vampire (*Desmodus rufus*) is a comparatively small-sized bat, measuring only about 3 inches in length, and of a reddish brown colour above, and usually some shade of yellowish brown beneath. It has no true molar teeth, and likewise no spur on the ankle for the support of the membrane between the legs. The geographical range of this species is large, extending from Central America to Southern Brazil on the east of the continent, and to Chile on the west.

The lesser blood-sucking vampire (*Diphylla ecaudata*) serves to connect the first species with the other members of the family, having a small rudimentary upper molar tooth on each side of both jaws, and also a tiny spur on the ankle. It is further distinguished by the middle portion of the membrane between the hind

legs being quite undeveloped, as well as by certain features connected with the lower incisor teeth, which are peculiar in having distinct notches on the summits of their crowns. The colour of this bat is very similar to that of the common species; but the size of the animal is slightly less. This smaller vampire, which appears to be confined to Brazil, is far from common; and there does not appear to be any account of its having been caught in the act of blood-sucking, although there is no doubt that this is its habit.

During the daytime these bats repose in caves or hollow trees, whence they issue forth for their nightly blood-sucking. It appears that when they have selected a victim for attack, they either settle down on or hover over the part to be operated on; and then proceed to shave away a thin portion of skin by a razor-like action of the sharp upper incisor teeth, by which the blood is caused to ooze from a number of the small capillary vessels, and is then sucked up by the mouth and swallowed. It is probable that blood constitutes their whole diet.

R. LYDEKKER

STORIES OF BATS

The fact that it is a beast of the night spares the bat the embarrassment of popular attention, and its habits and mode of life are little more known to the average townsman than are the ways of the gorilla. Tradition and folklore assign to it certain attributes and disabilities, and for the rest all is blank. The man who finds Truth without loving her, is likened to the bat, "which, though it have eyes to discern that there is a sun, yet hath such evil eyes that it cannot delight in the sun." That, however, is a decided advance upon the position of the man who holds that the bat, like the mole, is blind. A countryman of more than average intelligence will unconsciously libel the bat by appalling ignorance. Such a man known to the present writer is lord of a water-mill where bats abound. He knows the ways of every bird and every terrestrial beast in his county, yet he slanders the bat. He holds up a pole in the twilight where bats flutter in dozens, firmly believing the creatures to be so blind that they will, as he says, "butt into and stun themselves." Yet its marvellous sense of direction distinguishes the bat above other mammals.

In some parts of England it is held to be a distinct challenge of Fate to handle a bat. A certain child which carried home a dead bat was declared to be in mortal danger, for if there be evil in a living bat, the



THE LESSER BLOOD-SUCKING VAMPIRE

same bat handled when dead is doubly potent for mischief. And to this day nothing will shake the belief of that hapless child's nurse that an illness which did soon afterwards overtake him was not directly due to his possessing himself of the dead bat.

Where there is smoke there is fire, and there is often some sort of reason to be found for the fears entertained by country folk. The bat carries with it swarms of parasites, and therefore is not pleasant to handle. Even that keen naturalist, the Rev. J. G. Wood, was fain to release a bat which he had caught in broad daylight. Its parasites were too many for him. It is possible that this unpleasant characteristic of the bat may be at the foundation of the superstition that illness will attack the person who handles one.

In parts of the north of Scotland they have a pagan way of glorifying the bat. They have no greater love for it than the rest of their fellows have, but, as in Oriental lands the natives worship the tiger, the plague, and other ills which smite them, those Scots assert that if a bat favour a man or woman by touching him or her, marriage for the person so touched will follow within a year. It is surprising that the bat has not been assigned some minor rôle in the ceremonies of Hallowe'en. The French peasant sees nought but evil in the bat, for Rion, in his "*Erreurs et Préjugés Populaires*," informs us, "In the country one looks wrongly at the bat as a bad augury, and, by a barbarous prejudice, nails it, like a bird of prey, to the door of the barn. The same treatment is meted out to the owls and other nocturnal birds."

Seeing that the popular mind attributes to toads the power to subsist for untold ages enclosed in rock or coal, it is perhaps fit and proper that the mysterious, night-haunting bat should be credited with similar powers. Two cases are recorded, one from Selkirkshire, the other from Cheshire, of bats having been discovered, one immured in the heart of a cherry tree, the other in a pear tree. In both instances the person making the discovery allowed his prize to escape, believing it to be a creature of another world. Probably all that was needed to solve the mystery was an examination of the trees, which would have disclosed some unsuspected crevice by which the bat had gained ingress and egress to and from the trunk of the tree.

The present writer had an experience which was not a little puzzling. A bat was found during his search in a forgotten cellar beneath an old house. The cellar was a dungeon, down three flights of steps cut in the rock, and, at the top, was shut off from communication with the outer world by a massive iron door, concealed behind another door, which looked as if it were part of the ordinary oak wainscoting of the room. At the foot of each flight of steps was a circular chamber, and the lowest communicated by a passage with a historic castle a quarter of a mile away. This passage, however, was bricked up, the masonry apparently filling the opening completely from floor to ceiling. Yet here, in this lowest chamber, was a huge bat in excellent condition. How it had come there, how long it had been there, and upon what it had subsisted, no one could say. There was no food supply available from above, and at that depth in the pitch-black dungeon there could be

very little, if any, insect life. The only possible explanation was that there did exist some opening in the wall shutting off the passage from the dungeon to the castle, and that the bat was able to fly through this into the outer world by way of the subterranean galleries. The bat was secured and kept by the writer for a couple of days, when it made its escape, with no evidence of ill effects from its hermit-like mode of life.

The prejudice against bats has prevented them from being popular as pets, a circumstance that bats themselves need scarcely regret. Still, a tame bat is not wholly unknown. A captive great bat, or noctule, proved an interesting creature to its owner. Its own attractions were increased by the fact that it was the proud possessor of a young one, to which it devoted itself with true maternal solicitude. For its cradle, the little one sought the shelter of one of the capacious wings of its mother. Folded in the membrane of the wing, the blind and all but helpless baby bat was warm and snug, and secure as well from observations as from falls.

The parent in this case disregarded all insect food offered to it, but ate with evident relish minced raw meat. The adult bat was very particular about its toilet, and with its hind claws carefully combed itself, forming a parting of its fur from the centre of the head backwards, which for accuracy would have done credit to a dandy.

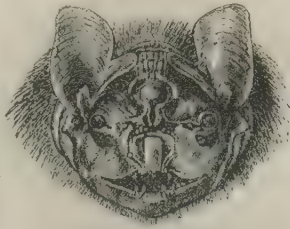
Shy of human company as bats generally prove, there is no invincible apathy to the friendship of man. Clark, in his "*Fauna of Mauritius*," mentions a bat which was not only tame, but showed intelligence enough to recognise its master and fly to him. Immediately the man entered the room, the bat recognised and welcomed him with its cries, and, if not at once taken up to be petted, climbed up his dress, rubbed its head against him, and licked his hands. If its master took anything in his hand, the bat's curiosity was not satisfied until it had examined the object by sight and smell, and when he sat down, the creature would hang head downwards from the back of his chair, carefully watching all his movements. The same

degree of tameness was developed in a British bat by Professor Thomas Bell, author of "*British Quadrupeds*." His bat, when liberated in the parlour, would fly to the hand of anyone who held up a fly towards it, and would take the fly without hesitation. If the insect were held between the lips, the bat would settle on its patron's cheek, and take the fly with the utmost gentleness; while, when a humming noise in imitation of an insect was

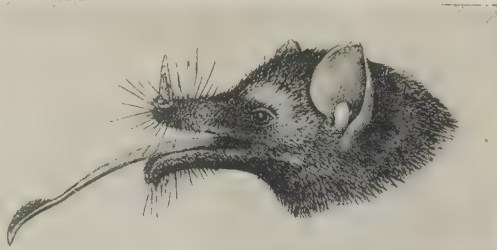
made, the bat would eagerly search about the lips for the supposed dainty. A bat rescued from the hands of a tormenting boy became a pet in another household. It took any form of food from its mistress, and lapped milk from her finger. Released at night, it would fly out in search of insects, but never failed to return at the end of a couple of hours, hanging to the window sash or sill until its mistress opened the window to admit it.

Apart from the value of the insectivorous bats, these curious mammals have a place in zoological economy by reason of the value of their guano. Extensive deposits of this product are tapped in Texas, Arkansas, and the Bahama Islands.

E. A. B.



HEAD OF THE CENTURION BAT



HEAD OF THE LONG-TONGUED VAMPIRE

ORDER III. INSECTIVORA

GENERAL SKETCH OF THE INSECT-EATING MAMMALS

By R. LYDEKKER

LACK of a vernacular name for that group of mammals of which the shrewmice, moles, and hedgehogs are the most familiar representatives renders it necessary to adopt an Anglicised form of the Latin term *Insectivora*, by which the group is known. This name refers to the insect-eating habits of most of the members of this order; and it is appropriate, since, excepting the bats, no other group of mammals preys so exclusively on insects, or other small creatures.

Most of the *Insectivora* are comparatively small in size; and, saving the family of tupais and some of the aquatic species, all are more or less of nocturnal habits. In the absence of strongly marked characteristics, such as wings in the bats, the group is by no means easy of strict definition, unless we enter upon the consideration of abstruse anatomical details.

In addition to their generally small size and nocturnal habits, the *Insectivora* may be recognised by the following structural features: all the toes are furnished with claws, and are in most cases five in number on each foot, while in no instance is either the thumb or the great toe capable of being opposed to the other digits. These animals walk either on the whole or the greater portion of the soles of their feet, and never on their toes only, in the manner of a cat or dog. Their upper molar teeth carry a number of small and sharp cusps, arranged either in a V-shaped or a W-shaped pattern; and the incisor teeth, of which there are not fewer than two pairs in the lower jaw, never assume the chisel-like form found in all rodents (rats, porcupines, hares, etc.); but the first or innermost pair is very frequently larger than either of the others, and these teeth are placed on the sides of the jaws. In no instance is one pair of the cheek teeth in each jaw modified so as to act with the scissor-like action characteristic of so many of the modern *Carnivora*.

Then, again, with the marked exception of the tenrec, the tusks, or canine teeth, are generally not markedly distinct from the other teeth, so that it is often a matter of some difficulty to decide—especially in the lower jaw—which teeth are incisors, which canines, and which premolars. This may be readily verified by comparing the skull of a hedgehog with that of a dog, in which the tusks cannot possibly be confused either with the incisors in front or with the premolars behind.

In the skeleton of the *Insectivora* there is, with the single exception of the peculiar African otter-shrew, always a pair of complete collarbones, or clavicles, connecting the bladebones (scapulæ) with the breastbone, by which the order is distinguishable from the *Carnivora*. Externally, *Insectivora* are very generally characterised by their extremely long, narrow, and mobile snouts, in which the muzzle is produced considerably in advance of the end of the lower jaw; while their bodies are covered either with fur, or, more rarely,

with a protecting armour of spines. On opening the skull, it will be found that the upper surface of the lobes of the brain is smooth, and thereby very different from the same organ in the *Carnivora*.

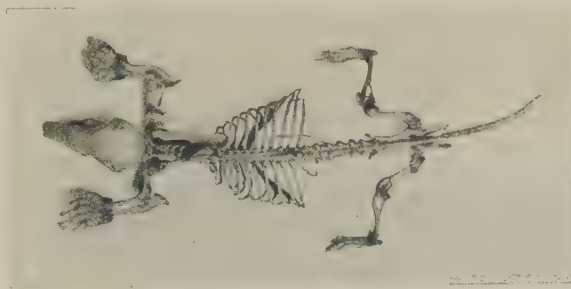
There are other distinctive characters, for the proper appreciation of which a knowledge of anatomy is requisite. If, however, all the points mentioned above receive due consideration, there will be little fear of confusing a member of the *Insectivora* with any other mammal, except it be a marsupial. The marsupials, however, are broadly distinguished by many important characteristics; while, with the exception of the selvas and opossums, marsupials are restricted to the Australian region, where *Insectivora* are unknown. Moreover, the selvas and most opossums are confined to South America, where *Insectivora* are absent; and there is accordingly not much risk of a living marsupial being mistaken for one of the *Insectivora*, or *vice versa*.

In all respects, as is well shown by their small and smooth brains, the *Insectivora* occupy a very low position in the mammalian series; and, together with some of the marsupial and egg-laying mammals of Australia, may be regarded as more nearly allied to

the original primitive mammalian stock than any other members of the class now existing. Their nearest relatives are the bats, which may be regarded merely as *Insectivora* specially modified for a life in the air. It must not, however, be supposed that any of these living *Insectivora* can be regarded as the ancestral form of the bats; such ancestors having totally disappeared ages and ages ago. From the evidence of extinct types, it is not

improbable that the *Insectivora* are allied to the ancestors of the modern *Carnivora*, as represented by the extinct group known as *creodonts*.

The *Insectivora* are widely scattered over the globe, although absent from the two large regions mentioned above. Some of the most curious types are found in Madagascar, Africa, and the West Indian Islands. Since the tendency is for low forms to disappear when brought into competition with higher types of animal life, it is interesting to observe that the *Insectivora* have either survived in islands, like Madagascar or Cuba, where the higher forms of mammals are few or wanting, or, in the continental areas, have acquired habits which serve to protect them from the attacks of foes. For instance, besides being strictly nocturnal, which is of itself a great protection, most *Insectivora* live in the depths of forests, or concealed among the stems and roots of coppices and shrubs, or in the deserted holes of other animals; while the moles of the Northern hemisphere and the golden moles of Southern and Eastern Africa have taken to a completely subterranean life, and the hedgehogs have acquired a special defence in their coat of thick-set spines. Others, again, like the water-shrews, the



THE SKELETON OF A MOLE
Photograph by Oxley Grabham

desmans of Europe and Asia, and the otter-shrews of Africa, have resorted to the water, and hide themselves during their periods of repose in holes in the banks of rivers and lakes; while the diurnal tree-shrews, or tupais, seek the security afforded by a life among the boughs of forest trees, after the manner of squirrels. Finally, the flying lemurs, or cobegos, are peculiar in possessing the power of taking flying leaps from tree to tree, and are thus safe during their hours of movement from most enemies except man; while when at rest they are protected by the wonderful resemblance existing between their bodies, with the parachute-like expansions of skin, and the bark of the trunks or boughs of the trees to which they cling. This resemblance seems most marked in the young, in which the parachute is marked with yellow spots, assimilating to the lichens on the bark.

Many of the Insectivora have a strong, unpleasant odour, which also serves as a protection; this being most evident in the shrewmice, and more especially among the musk-shrews of the genus *Crocidura*, the large Indian representative of which is known to Anglo-Indians as the musk-rat. Apparently this musky odour is most developed among shrewmice in the males, since in many cases the members of that sex alone, both in the case of the ordinary land-shrews and the water-shrew, possess a lateral gland which produces the musky smell. Desmans have a scent-gland under the tail.

In both the moles and the golden moles the eyes, in accordance with the exigencies of a subterranean existence, have become more or less degenerate, although the degree of this degeneration varies even in the different European species of moles.

In the African golden moles the eye has sunk only into the true skin, or dermis, where it is surrounded by the hair-roots; but the eye-muscles have disappeared, as has the vitreous humour, while the lens and iris are very degenerate. The optic nerve is

retained in some instances and lost in others. Despite its comparatively superficial position, the eye is, however, not visible externally; the loss of the eye-muscles is an unusual feature. That the eye, even were the cleft at the proper angle for admitting light rays, is useless for vision, is certain; and it is improbable that it is capable of detecting even degrees of light.

These golden moles are peculiar among mammals on account of the iridescent metallic sheen of their fur, which exhibits, in life, a most beautiful play of colours. The object of such a peculiar type of colouring in animals that spend their lives underground is not easy to guess.

The hedgehog family, which includes both the hedgehogs and the gymnuras, or rat-shrews, is one of the most ancient in the mammalian class, both the extinct genus *Necrogymnurus* and the existing *Erinaceus* being represented in the Oligocene phosphorites of Central France: the persistence of the second genus may be attributed to the defensive coat of spines with which its members are furnished. From the aforesaid genus *Necrogymnurus*, which is probably the oldest representative of the family known to us, there seem to have sprung two branches, one including the extinct *Galerix* and *Lanthanotherium* and the modern Bornean *Gymnura*, and the other the true hedgehogs (*Erinaceus*) and the Malay *Hylomys*.

Another indication of antiquity in the hedgehog is the early date at which the foetus assumes the characteristic external form of the genus, this taking place at a much earlier stage of development than in most other mammals.

Shrewmice are very valuable to the farmer and gardener. Mr. A. F. Shull has shown that an American species, *Blarina brevicaudata*, is a determined enemy of snails and field-mice, more especially the short-tailed kinds commonly known as voles. The circumstance which led to the investigation was the finding on the shore in the neighbourhood of Ann Arbor of a number



A MOLE COLONY IN THE NEW FOREST

Photograph by F. R. Hinkins & Son

THE INSECTIVORA

of heaps of snails, some of which contained more than a hundred shells, either full or empty. Observation showed that these snail-heaps were invariably placed near the apertures of burrows afterwards ascertained to be the dwelling-places of the above-mentioned species of shrewmouse. It was eventually found that the snails are collected by the shrewmice in winter for food, and that in cold weather they are stored on the surface of the ground, but moved into the burrows as the temperature rises. From the number of heaps it is evident that large numbers of snails are consumed by the shrewmice, each of which is estimated to eat on an average eighteen per month. As regards other food, the author calculates that every shrewmouse consumes on an average eight field or other mice, ninety insects, seventy-eight larvæ, and fifty-three earthworms per month. Whether the destruction

of the worms is an advantage may be a question, but all the other creatures consumed are distinctly harmful, and the shrewmice deserve protection at the hand of the farmer, since it is scarcely too much to say that they are nearly as valuable as owls.

The African golden moles are unique among living mammals in possessing perfectly tritubercular molar teeth. Those of the tenrecs of Madagascar, of the solenodons of the West Indies, and of the otter-shrew of Equatorial Africa are, however, of the same general type, and it is evident that all these groups are more or less nearly related. The primitive character of their dentition and their curiously scattered and isolated distribution point to the extreme antiquity of this assemblage of Insectivora, which may have dispersed from a great land-centre long since submerged beneath the ocean.

R. LYDEKKER

TABLE OF INSECTIVORA DEALT WITH IN THIS WORK

ORDER III. INSECT-EATING MAMMALS— INSECTIVORA SUBORDER I.		SPECIES		SPECIES	
Flying Lemurs— <i>Dermoptera</i>		True's gymnura <i>Podogymnura truei</i>		Hairy-tailed mole <i>Scapanus americanus</i>	
FAMILY		GENUS 5		GENUS 6	
Cobegos, or <i>Kaguans</i> — <i>Galeopithecidae</i>		Hedgehog-Shrew— <i>Neotetracus</i>		Star-nosed Mole— <i>Condylura</i>	
GENUS		SPECIES		SPECIES	
Cobego— <i>Galeopithecus</i>		Sze-chuen hedgehog-shrew <i>Neotetracus sinicus</i>		Star-nosed mole <i>Condylura cristata</i>	
SPECIES		FAMILY 2		GENUS 7	
Cobego <i>Galeopithecus volans</i>		Shrewmice— <i>Soricidae</i>		Typical Moles— <i>Talpa</i>	
Philippine cobego <i>G. philippensis</i>		GENUS 1		SPECIES	
SUBORDER II.		Typical Shrewmice— <i>Sorex</i>		European mole <i>Talpa europæa</i>	
Tupais and Jumping Shrews— <i>Menotyphla</i>		SPECIES		Short-tailed mole <i>T. micrura</i>	
FAMILY 1		European shrewmouse <i>Sorex araneus</i>		Savi's mole <i>T. caeca</i>	
Tupais, or Tree-Shrews— <i>Tupaia</i>		Pigmy shrewmouse <i>S. minutus</i>		Roman mole <i>T. romana</i>	
GENUS 1		Alpine shrewmouse <i>S. alpinus</i>		GENUS 8	
Typical Tupais— <i>Tupaia</i>		Bendire's shrewmouse <i>S. bendirei</i>		Scaptonyx	
SPECIES		Cooper's shrewmouse <i>S. cooperi</i>		SPECIES	
Bornean tupai <i>Tupaia tana</i>		Marsh shrewmouse <i>S. palustris</i>		Yellow-tailed mole <i>Scaptonyx fuscicaudata</i>	
Madras tupai <i>T. ellioti</i>		Swimming shrewmouse <i>S. hydrodromus</i>		FAMILY 4	
Malay tupai <i>T. ferruginea</i>		GENUS 2		Tenrecs— <i>Centetidae</i>	
GENUS 2		Short-tailed, or Earless, Shrewmouse— <i>Blarina</i>		GENUS 1	
Pen-tailed Tupai— <i>Ptilocercus</i>		SPECIES		Tenrec— <i>Centetes</i>	
SPECIES		Common short-tailed shrewmouse <i>Blarina brevicaudata</i>		SPECIES	
Pen-tailed tupai <i>Ptilocercus lowi</i>		GENUS 3		Great tenrec <i>Centetes ecaudatus</i>	
FAMILY 2		Water-Shrew— <i>Crossopus</i>		GENUS 2	
Jumping Shrews— <i>Macroscelidae</i>		SPECIES		Streaked Tenrecs— <i>Hemicentetes</i>	
GENUS 1		Water-shrew <i>Crossopus</i> (or <i>Neomys</i>) <i>fodiens</i>		SPECIES	
Typical Jumping Shrews— <i>Macroscelides</i>		GENUS 4		Streaked tenrec <i>Hemicentetes semispinosus</i>	
SPECIES		Musk-Shrews— <i>Crocridura</i>		Black-headed tenrec <i>H. nigriceps</i>	
Common jumping shrew <i>Macroscelides typicus</i>		SPECIES		GENUS 3	
Cape jumping shrew <i>M. proboscideus</i>		Spider musk-shrew <i>Crocridura russulus</i>		Hedgehog-Tenrecs— <i>Ericulus</i>	
Algerian jumping shrew <i>M. rozeti</i>		European musk-shrew <i>C. suaveolens</i>		SPECIES	
Rock jumping shrew <i>M. tetradactylus</i>		Brown musk-shrew <i>C. murina</i>		Hedgehog tenrec <i>Ericulus setosus</i>	
GENUS 2		Grey musk-shrew <i>C. cærulea</i>		Telfair's tenrec <i>E. telfairi</i>	
Long-nosed Jumping Shrews— <i>Rhynchocyon</i>		Blyth's musk-shrew <i>C. fuliginosa</i>		GENUS 4	
SPECIES		GENUS 5		Long-tailed Tenrec— <i>Microgale</i>	
Peters's long-nosed jumping shrew <i>Rhynchocyon petersi</i>		Burrowing Shrew— <i>Anurosorex</i>		SPECIES	
East African long-nosed jumping shrew <i>R. cirnei</i>		GENUS 6		Long-tailed tenrec <i>Microgale longicaudata</i>	
SUBORDER III.		Swimming Shrews— <i>Chimarrogale</i>		GENUS 5	
Shrewmice, Moles, Hedgegogs, etc.— <i>Insectivora vera</i>		SPECIES		Water-Tenrec— <i>Limnogale</i>	
FAMILY 1		Himalayan swimming shrew <i>Chimarrogale himalayica</i>		SPECIES	
Hedgehog Tribe— <i>Erinaceidae</i>		Japanese swimming shrew <i>C. platycephalus</i>		GENUS 6	
GENUS 1		GENUS 7		Rice-Tenrecs— <i>Oryzorictes</i>	
Hedgehog— <i>Erinaceus</i>		Web-footed Shrew— <i>Nectogale</i>		SPECIES	
SPECIES		SPECIES		Four-toed rice-tenrec <i>Oryzorictes tetradactyla</i>	
European hedgehog <i>Erinaceus europæus</i>		FAMILY 3		Five-toed rice-tenrec <i>O. hova</i>	
Madras hedgehog <i>E. micropus</i>		Moles— <i>Talpidae</i>		FAMILY 5	
Long-eared Afghan hedgehog <i>E. megalotis</i>		GENUS 1		Solenodons— <i>Solenodontidae</i>	
Collared hedgehog <i>E. collaris</i>		Desmans— <i>Myogale</i>		GENUS	
Saharan hedgehog <i>E. algirus</i>		SPECIES		Solenodon— <i>Solenodon</i>	
White-bellied hedgehog <i>E. albiventris</i>		Russian desman <i>Myogale moschata</i>		SPECIES	
GENUS 2		Pyrenean Desman <i>M. pyrenaica</i>		Taytian solenodon <i>Solenodon paradoxus</i>	
Gymnuras, or Rat-Shrews— <i>Gymnura</i>		GENUS 2		Cuban solenodon <i>S. cubanus</i>	
SPECIES		Mole-Shrew— <i>Urotrichus</i>		FAMILY 6	
Raffles's gymnura <i>Gymnura rafflesi</i>		SPECIES		Otter-Shrews— <i>Potamogalidae</i>	
White gymnura <i>G. alba</i>		GENUS 3		GENUS 1	
GENUS 3		Mole-Shrew— <i>Uropsilus</i>		Otter-shrew <i>Potamogale velox</i>	
Hylomys		SPECIES		GENUS 2	
SPECIES		Sze-chuen mole-shrew <i>Uropsilus soricipes</i>		Geogale	
Short-tailed gymnura <i>Hylomys suillus</i>		GENUS 4		FAMILY 7	
GENUS 4		Web-footed Mole— <i>Scalops</i>		Golden Moles— <i>Chrysochloridae</i>	
Podogymnura		SPECIES		GENUS	
		Web-footed mole <i>Scalops aquaticus</i>		Golden Mole— <i>Chrysochloris</i>	
		GENUS 5			
		Hairy-tailed Mole— <i>Scapanus</i>			

THE COBEGOS, OR FLYING LEMURS

FEW mammals have been a greater puzzle to naturalists as regards their proper systematic position than the cobegos, colugas, kubongs, or kaguans, of the Malay region. These mammals are known to the natives by these names, but are commonly spoken of by Europeans either as flying lemurs or flying rats. They constitute the genus *Galeopithecus*, which is the type of a distinct family (*Galeopithecidae*), and as they come nearer to the Insectivora than to any other group they are regarded as forming a special division of the order, although some naturalists consider that they approximate more closely to the bats, and should form a separate order by themselves, the Dermoptera.

The most characteristic external feature of these curious animals is the parachute formed by folds of skin running along the sides of the neck and body, and connected with the long and slender limbs, of which the fingers and toes are webbed as far as the roots of their strong and curved claws. This parachute-like membrane is continued between the hind legs to include the whole of the long tail, in which respect these animals differ from the flying squirrels. One of their most peculiar features consists in the structure of their lower front, or incisor, teeth, which are unlike those of any other mammal, or indeed of any animal. In both jaws these incisor teeth are expanded laterally, and compressed from front to back, with a number of cusps on their summits, and those of the lower jaw have very wide, flattened crowns, penetrated by a number of parallel vertical slits, so that they resemble small combs mounted upon narrow stems. The outermost of the two pairs of upper incisor teeth, as well as the upper tusk, or canine, which is nearly similar to the incisors, are inserted in the jaws by two distinct roots, this being also a unique feature among living mammals, although moles and hedgehogs have two roots to their upper tusks.

The Malay cobego is found in Sumatra, Borneo, Java, the Malay Peninsula, Tenasserim, and Siam, and is known as *Galeopithecus volans*. It is about the size of a cat; and its habits have been well described by Dr. A. R. Wallace, who met with it in Sumatra. He observes that the cobego "is sluggish in its motions, at least by day, going up a tree by short runs of a few feet, and then stopping a moment as if the action was difficult. It rests during the day, clinging to the trunks of trees, where its olive or brown fur, mottled with irregular whitish spots and blotches, resembles closely the colour of mottled bark, and no doubt helps to

protect it. Once, in a bright twilight, I saw one of these animals run up a trunk in a rather open place, and then glide obliquely through the air to another tree, on which it alighted near its base, and immediately began to ascend. I paced the distance from the one tree to the other, and found it to be seventy yards; and the amount of descent I estimated at not more than thirty-five or forty feet, or less than one in five. This, I think, proves that the animal must have some power of guiding itself through the air, otherwise in

so long a distance it would have little chance of alighting upon the trunk. The *galeopithecus* feeds chiefly on leaves, and possesses a very voluminous stomach and long convoluted intestines. The brain is very small; and the animal possesses such a remarkable tenacity of life that it is exceedingly difficult to kill it by any ordinary means.

The tail is prehensile, and is probably made use of as an additional support while feeding. The animal is said to have only a single young one at a time; and my own observation confirms this statement, for I once shot a female, with a very small, blind, and naked little creature clinging closely to its breast, which was quite bare and much wrinkled, reminding me of the young of the marsupials, to which it seemed to

form a transition. On the back, and extending over the limbs and membrane, the fur of these animals is short but exquisitely soft, resembling in its texture that of the chinchilla."

Of the slightly smaller Philippine cobego (*G. philip-*

pinensis), restricted to the islands from which it takes its name, a short account is given by Professor Moseley in the "Naturalist on the Challenger." When on Basilan Island, one of the Philippines, this naturalist was conducted by a native guide to a spot where "some few trees were standing isolated, not having been as yet felled, on the clearing. On one of these, after much search, a kaguan was seen hanging to the shady side of a tall trunk. It was an object very easily seen, much more so than I expected. It moved up the tree with a shambling, jerky gait, hitching itself up apparently by a series of short springs. It did not seem disposed to take a flying leap, so I shot it. It was a female with a young one clinging to the breast. It was in a tree at least forty yards distant from any



THE COBEGO

other, and must obviously have flown that length to reach it."

In their leaf-eating habits the cobegos are apart from all other Insectivora, in this respect occupying the same relationship to the typical members of the order as the flying foxes bear to the typical bats. Instead of possessing the power of true flight, the cobego merely enjoys spurious flight, or the power of continuing the extension of its leap by the aid of its parachute.

It would require comparatively little further modification to alter a cobego into a creature much resembling a bat and endowed with the power of true flight; and we thus gain a good idea of the way in which the bats may have been derived from primitive Insectivora. It

must not, however, be thereby supposed that the cobego is in any sense the missing link between these orders; its leaf-eating habits, as well as the peculiar structure of its incisor teeth, being alone amply sufficient to disprove its claim to that position; the insect-eating bats, which appear to be the ancestral groups of the order to which they belong, having in all probability been directly derived from the insect-eating section of the Insectivora. The cobego should, perhaps, be regarded rather as the sole representative of a side branch, which, while to some extent simulating the bats, never gave rise to descendants showing special modifications for true flight. The young cobego is much less sparsely haired than the adult.

THE TUPAIS OR TREE-SHREWS

THE Asiatic tupais, or tree-shrews, constitute the first family (*Tupaia*) of the suborder Menotyphla, the members of which are incapable of flight, and have their front, or incisor, teeth of a normal form, while as a general rule the intestine is provided with a blind appendage, or cæcum.

The tupais, which are confined to the Indo-Malay region, take their name of tree-shrews from their strictly arboreal habits; and are small, long-tailed animals, so closely resembling the smaller squirrels in external appearance as to be frequently mistaken for them. Indeed, the native term tupai is applied indifferently by the Malays both to them and to squirrels; the affix "tana," serving to denote members of the present group. That they have really nothing to do with squirrels is shown by the teeth; these animals, in place of a single pair of chisel-like incisor teeth, having two pairs of small incisors in the upper jaw, and three pairs in the lower.

Tupais have the upper molar teeth with broad crowns carrying a number of cusps, arranged in the form of the letter W. The socket of the eye, or orbit, is surrounded by a bony ring, whereas in other members of

the order it is open behind; and they are further distinguished from other Insectivora not only by their completely arboreal, but likewise by their diurnal habits, as they feed entirely by day. They resemble squirrels in the general form of the body and limbs, and in possessing more or less bushy tails. They have thirty-eight teeth, of which $\frac{2}{3}$ are incisors, $\frac{1}{3}$ canines, and $\frac{2}{3}$ cheek teeth, on each side of each jaw. Their feet, like those of squirrels, are naked beneath, with moderately curved and sharp claws. The muzzle is sharply pointed, the ears are small and rounded, and the long hair of the bushy tail is confined to its upper surface and sides, the under surface having much shorter hair.

TYPICAL TUPAIS

There is a considerable number of tupais, which have a wide distribution over the Oriental region. Ranging over India, Burma, the Malay Peninsula, the Nicobar Islands, Sumatra, Java, Borneo, and the Philippines, they are very much alike in general appearance, the species differing mainly in respect of size and colour, as well as in the length of the fur. Many are restricted to particular islands; the Bornean, the Nicobar, and the Philippine tupais being respectively unknown out of the islands from which they take their names. Others, again, have even a still more restricted distribution; two species having hitherto been obtained only in the forests of Mount Dulit in North Borneo. Tupais may be found in clumps of trees as well as in forests; and, in addition to their resemblance to squirrels, they simulate these animals very closely in their movements, as they may not infrequently be seen sitting up on their hind quarters and holding their food in their fore paws. Their food consists of insects and fruit; and although insects are usually sought on trees, tree-shrews may sometimes be seen hunting for food on the ground.

The largest member of the group is the Bornean tupai (*Tupaia tana*). The Madras tupai (*T. ellioti*), found in the forests of the greater part of peninsular India to the south of the plains of the Indus and Ganges, is a well-known species, of which the head and body measure from seven to eight inches in length, while the tail, including the hair, is about an inch



THE BORNEAN TUPAI

longer. From the fact of the individuals of this species being sometimes met with lying dead in the jungle, it would seem that a fate similar to that which overtakes at certain times of the year the common English shrewmouse also befalls the tupais. The Malay tupai (*T. ferruginea*) is a rather smaller species, with a much wider distribution, extending from Assam and the Eastern Himalaya, where it is found at elevations of from three thousand to six thousand feet, to Burma and the Malay Islands.

Of the Malay species, General M'Master writes that it "is a harmless little animal, in the dry season living in trees, and in the monsoon entering our houses, and in impudent familiarity taking the place held in India by the common palm-squirrel; it is, however, probably from its rat-like head and thievish expression, very unpopular. I cannot endorse the statement as to their extraordinary agility, for they did not appear to me to be nearly as active as squirrels; at least I remember one of my terriers on two occasions catching one—a feat which I have never seen any dog do with a squirrel. Cats, of course, often pounce upon them." The familiarity of these tupais, and the ease with which they can be tamed, are mentioned by all who have written of their habits. After feeding, they are in the habit of dressing their fur and paws, after the manner of a cat, and they are partial to water both as a bath and to drink.

In disposition they are pugnacious in the extreme, fighting fiercely with one another when confined together in a cage, and in their wild state driving away all intruders of their own kind from their particular preserves. Their usual call is a short, peculiar, tremulous, whistling sound, which, when they are angry, is changed to shrill, protracted cries.

The resemblance of tupais to squirrels illustrates what is termed "mimicry," and may have been originally due to the extreme agility of the latter animals insuring them from pursuit by enemies. Hence it would be an

advantage for a slower animal to be mistaken for a squirrel. There is, however, a remarkable little squirrel (*Sciurus tupaoides*) found in Sumatra and Borneo, which appears, for some reason or other, to simulate the tree-shrews, and thus to afford an instance of reversed mimicry. Not only does this squirrel resemble

the Malay tupai in size and the texture and colouring of its fur, but the muzzle is similarly elongated, and there is the pale shoulder-streak usual in the tupai.

PEN-TAILED TUPAI

Apart from other species of the typical genus, the only other living member of the family is the pen-tailed tupai (*Plilocercus lowi*), which so differs in the structure of its tail as to represent a distinct genus. The animal is between five and six inches in length, exclusive of the long tail, which is characterised by its upper two-thirds being naked and the lower third ornamented with a double fringe of long hairs, arranged like the vanes of a feather. The general colour of the fur is blackish brown above, with the cheeks and lower parts yellowish, and a dark streak running backwards from the

muzzle to encircle the eye; while the tail is black, with most of the long hairs of the "pen" white.

The first specimen known was captured in the house of Sir James Brooke, at Sarawak; and the species was considered to be confined to Borneo; but it was afterwards discovered in some of the small islands in the neighbourhood, and also in the Malay Peninsula.

Certain fossil Insectivora from the Tertiary deposits of Europe have been regarded as nearly related to the tupais. For instance, the genus *Lanthanotherium* was long considered very closely related to the living tree-shrews, while *Galerix* was supposed to present characters connecting it both with the tree-shrews and the jumping shrews. Now, however, both groups are thought to be more nearly allied to the gymnuras.



EAST AFRICAN LONG-NOSED JUMPING SHREW

THE JUMPING SHREWS

As the tupais simulate squirrels, so the jumping shrews (family *Macroscelidæ*), which are nearly allied, approximate in form to jerboas and gerbils, both of which belong to the Rodent order; but while the resemblance in the former instance is a case of true mimicry, in the other it appears to be merely due to adaptation to a similar mode of life.

The jumping shrews, or, as they are sometimes called, in allusion to their prolonged snouts, elephant shrews, are the African representatives of the tupais. They are exclusively confined to Africa, and, while agreeing with the members of the preceding family in the relatively large size of their brains, as well as in certain other features of their internal anatomy, are distinguished by structural differences entitling them to be regarded as a separate family. Among these differences is the circumstance that the socket of the eye is not surrounded by a bony ring, but is open behind. Then again, the metatarsus, or that portion of the foot immediately below the ankle-joint,

instead of being of the normal proportions, is greatly elongated, so as to make the whole foot nearly as long as the lower half of the leg. Further, instead of pursuing an arboreal and diurnal life, like tupais, jumping shrews restrict themselves to the ground, upon which they progress by leaps, and are mainly or entirely nocturnal.

The typical jumping shrews, constituting the genus *Macroscelides*, are characterised by the number of their teeth and toes. With one exception, these animals have forty or forty-two teeth, of which $\frac{3}{8}$ are incisors, $\frac{1}{4}$ canines, and $\frac{6}{8}$ (or $\frac{7}{8}$) cheek teeth on each side of the jaws. Invariably they possess five toes on the fore feet; while, with the single exception of the rock jumping shrew, where there are only four, the same number obtains in the hind foot. The ears are large and the tail is naked and rat-like.

Numerous species of this genus are distributed over a large part of the African continent, their range extending from the Cape to Algiers; and most of

THE HEDGEHOG TRIBE

them being very much alike as regards size, form, and colour. The Cape jumping shrew (*M. proboscideus*) is a tawny-brown animal of about five inches in length, exclusive of the tail; the length of the latter being about three inches. These shrews are very common in South Africa, where they dwell among grass and bushes, coming forth at dusk from their hiding-places to scour the plains in search of their insect food. The Algerian jumping shrew (*M. rozeti*) is a very similar species, and is said to vary the insect diet of the Cape species with a mixture of vegetable food. Like the tupais, this species can be readily tamed and soon becomes familiar.

Of larger size than many of the other species of the genus, is the rock jumping shrew (*M. tetradactylus*), of the Mozambique coast of East Africa, which derives its name from dwelling in rocky districts, where it conceals itself in the crannies and clefts of rocks. The most important characteristic of this species is the presence of only four toes in the hind feet, the small inner toes found in the other species having disappeared. It is likewise peculiar in having but forty teeth, owing to the loss of the last molar on each side of the lower jaw; and for these reasons, this and a few allied species are often consigned to a separate genus, *Petrodromus*.

LONG-NOSED JUMPING SHREWS

More remarkable than any of the above are the long-nosed jumping shrews, of the genus *Rhynchocyon*,

of which there are several species from Zanzibar and the adjacent regions of the East Coast of Africa. These are distinguished from the preceding group by having only thirty-six teeth, and four toes on both fore and hind feet; while the hind limbs are relatively shorter than in the typical jumping shrews, and the muzzle is so much produced as to form a distinct trunk. The reduction in the number of the teeth is due to the disappearance of two out of the three pairs of incisors in the upper jaws; and in very aged individuals even the single remaining pair may be shed, thus leaving the creature without any upper front teeth. The length of the head and body of the typical *R. petersi* is about eight inches; and that of its long scaly, rat-like tail, somewhat less. The general colour is rusty brown, becoming nearly black on the top of the head, back, and hind quarters, while the flanks have some bright reddish spots just below the hind part of the back. Other species, such as the East African *R. cirnei*, however, are olive grey in colour, with a number of yellowish spots on the back.

From the reduction in the number of the teeth and toes, as well as from the prolongation of the muzzle, the long-nosed jumping shrews are more specialised than the members of the typical group, and from their relatively shorter hind legs, it may be assumed that they are less habitual leapers than the latter.

The typical species, which was first described by Professor Peters, lives in holes in the ground, and issues forth at night in search of the insects of which its food consists.

THE HEDGEHOG TRIBE

THE hedgehogs and their near allies, the gymnuras or rat-shrews, constitute the first representatives of the typical Insectivora, or Insectivora Vera, in which there is never a cæcum to the intestine. They form the family *Erinaceidæ*. The brain is relatively smaller, and the union of the front elements of the pelvis in the middle line on the inferior aspect of the body is shorter, than in the preceding families. In the skull there is not even a trace of any bony process to mark off the limit of the socket of the eye from the larger hollow containing the muscles that work the lower jaw. With the exception of one species, all the members of the family have five-toed feet, provided

with simple claws not adapted for digging; this feature being in accordance with their purely terrestrial and non-fossorial habits. And the broad first and second molar teeth of the upper jaw are characterised by having five distinct cusps, of which the central one is very small, and connected with the two inner ones by a pair of oblique ridges.

The European hedgehog, or urchin, which is the largest of the British Insecti-

vora, is the best-known representative of a somewhat extensive genus (*Erinaceus*) distributed over the greater portion of Europe, and parts of Africa and Asia, although unknown in Madagascar, the Malay Peninsula and Islands, Burma, Siam, and Southern China.

The essential characteristics of the hedgehogs, as distinct from the gymnuras, are to be found in the dense coat of short spines covering the back and sides of the body, and in the shortness of the tail. Hedgehogs have thirty-six teeth, of which, on each side, $\frac{2}{3}$ are incisors, $\frac{1}{3}$ canines, and $\frac{1}{3}$ cheek teeth. The first pair of front, or incisor, teeth in the upper jaw have remarkably long crowns, which are widely

separated from one another in the middle line; while the two remaining incisor teeth on each side of the same jaw are much smaller. The middle region of the palate of the skull contains some open spaces not occupied by bone. The European hedgehog (*Erinaceus europæus*) is characterised by the short and almost imperceptible neck, the pig-like snout, from which it derives its popular name, and the shortness of its limbs. Exclusive



THE JUMPING SHREW

of the short, naked tail, which measures about one and a half inches, an average-sized hedgehog is about ten inches in length.

The great peculiarity of all hedgehogs is their power of rolling themselves up into a ball-like form, presenting an array of spines, impenetrable to most other animals. This process is effected by the aid of an extraordinary development of a layer of muscles found beneath the skin of most mammals, known as the *panniculus carnosus*. When rolled up, the head and feet are tucked inwards, so that only the spines are exposed, and it requires a bold dog or fox to attack a hedgehog when in this condition. Under the microscope, the spines are seen to be marked by a number of parallel longitudinal grooves; the ridges between them being ornamented in some of the foreign species with rows of tubercles. Hedgehogs, as stated on p. 337, date from a remote antiquity, and it is due to this protective armour of spines that animals of such low organisation and of such comparatively large size have been enabled to survive without resorting to the protection afforded by a subterranean or aquatic mode of life.

The food of the European hedgehog is very varied, including insects, worms, slugs, snails, lizards, snakes, birds' eggs, rats, mice, and other small animals; while roots and fruit are also consumed to a certain extent. The partiality of hedgehogs for insects is often taken advantage of in ridding houses of beetles and cockroaches; although the hedgehog itself not infrequently comes to an untimely end by a too close approach to the kitchen stove for the sake of warmth.

A hedgehog kills a snake by inflicting a series of bites, and quickly assuming the defensive when threatened with attack. That eggs are largely consumed by these animals is proved by the readiness with which they are caught in traps thus baited. On account of such depredations, as well as from their destructiveness to young birds, they are much persecuted by gamekeepers. There is at least one instance on record of a hedgehog having attacked a young leveret, which it would doubtless have despatched had it not been interrupted.

Hedgehogs venture forth from their hiding-places in hedges, coppices, or shrubberies during summer as soon as the dew of evening begins, and may be detected devouring worms or other prey on moonlight nights. A worm is eaten slowly by being seized by one extremity and turned from side to side of the mouth while it is being chewed by the sharp cheek teeth; a similar process taking place in the case of a snake.

Although properly nocturnal in their habits, hedgehogs may occasionally be met with searching for food during the day; and it has been suggested that on such occasions they are driven to depart from their ordinary habits by the necessity of procuring a sufficient supply of food for their young, which are usually produced during the months of July and August, and do not exceed four in a litter, although it was formerly considered that the number might be as many as eight. Occasionally a second litter is produced during the autumn; and it is believed that the period

of gestation is not longer than a month. The newborn young are almost naked, and their imperfect spines are soft, flexible, and white, although rapidly hardening in the course of a few days. They are at first totally blind, and incapable of rolling themselves up. The nest in which the young are born is carefully constructed and protected from rain by a roof. In winter the European hedgehog hibernates completely, laying up no store of food, but retiring to a nest of moss and leaves, where, rolled up in a ball, it lies torpid till awakened by the returning warmth of spring. As a rule, hedgehogs are comparatively silent, but on occasions they give vent to a sound something between a grunt and a low piping squeak.

The range of the hedgehog in Britain includes the whole of England and portions of Ireland, but does not extend beyond the middle of Scotland; its presence in the Shetland Islands being probably due to human introduction. Eastwards it was considered to range to Eastern China and Amurland; but its Transcaucasian and Siberian representatives have been referred to distinct species. In the opposite direction the range of the European species embraces the region from

63° N. in the Scandinavian Peninsula, to Southern Italy, Asia Minor, and Syria. Not only is the European hedgehog found in the lowlands of the regions over which it extends, but in the Alps it ascends to an elevation of six thousand feet, and in the Caucasus to upwards of eight thousand feet above the sea-level.

Among the numerous species of hedgehogs, the European animal and its immediate relatives are in some respects peculiar. In them the fur mingled with the spines is very coarse and harsh, and the upper tusk, or canine tooth (the fourth tooth from the extremity of the muzzle), is inserted by a single root, while in the other members of the group the fur is softer and finer, and the upper canine tooth has two roots, and closely resembles the cheek teeth.

Hedgehogs are represented by several species in India characterised by having minute tubercles on the ridges of their spines. It is remarkable that while one of these hedgehogs (*E. micropus*) is found in Madras, no representative of the genus is recorded from the Central Provinces and Bengal, the other species occurring in the North-West Provinces, the Punjab, etc.

Little is known of the habits of these Indian species, and nothing as to their breeding; although it is probable that in both respects they conform closely to their European cousin. The long-eared Afghan hedgehog (*E. megalotis*), common in the neighbourhood of Kandahar and Quetta, hibernates, but the species from the Punjab and Southern India are active at all seasons of the year, thus showing how absolutely dependent is the habit of hibernation upon climate.

The collared hedgehog (*E. collaris*), found in North-Western India, inhabits sandy country, hiding in holes beneath thorny bushes, or in tufts of grass during the day, feeding chiefly on insects, especially a species of cockroach, and also on lizards and snails. It makes a grunting noise when irritated, and when touched suddenly jerks up its back so as to throw its spines



THE HEDGEHOG

THE GYMNURAS

forward, making at the same time a sound like a puff from a pair of bellows. The Afghan hedgehog feeds on the slugs and snails so common in the fields round Kandahar, as well as worms, insects, and lizards. It hides during the day in holes; and hibernates from the end of October or beginning of November till February.

In Africa hedgehogs occur in different widely separated areas of the continent. Some species are met with in the Cape district, and others in the regions to the north of the Sahara (*E. algirus*), and in Egypt, as well as on the West Coast. One of these (*E. albiventris*) is peculiar in having lost the inner toe of the hind foot; although its claw has been found on one foot of an adult female from Lagos, as well as on both feet of young specimens from the same locality.

Fossil hedgehogs are met with in the Tertiary rocks of Europe as far back as the Oligocene period. Some of the extinct hedgehogs belong to the existing genus *Erinaceus*; and one (*E. aningensis*), from the middle Tertiary freshwater limestones of Baden, appears to be allied to the Algerian hedgehog, being totally different in the structure of its teeth from the European species. Others are distinguished by having a complete bony roof to the palate, and form a distinct genus, which may be allied in this respect to the gymnuras.

GYMNURAS, OR RAT SHREWS

The gymnuras, which are not unlike large, rough-haired shrews, take the place of the hedgehogs in Burma and the Malay region. Although closely allied to the hedgehogs in the structure of their teeth and other details of their anatomy, these Insectivora are so unlike them in external appearance that it is difficult to believe in their close affinity. It must be remembered, however, that the spines of the hedgehogs totally alter the appearance of the creature from what it would be, if unprovided with these appendages; and if we were to compare a gymnura with a young hedgehog, in which the spines are still rudimentary, the difference of aspect would not be so very marked.

Gymnuras are distinguished from hedgehogs by the total absence of spines; and typically by the long, naked tail, from which they derive their name. Further points of distinction are afforded by the complete bony roof to the palate, and also by the larger number of teeth, which is upwards of forty-four. The large and typical number of teeth characteristic of these animals is very rarely met with among existing mammals, although it was common among extinct forms; and in this respect the gymnura betrays the antiquity of the group to which it belongs.

Raffles's gymnura (*Gymnura rafflesi*)—so named after Sir Stamford Raffles—is an animal somewhat resembling a large rat, with a long, pointed nose; the length of the head and body varying from twelve to fourteen inches, and that of the long, rat-like tail from eight and a half inches to nine and a half inches. The head and body are generally parti-coloured, with considerable individual variation in the distribution of the black and white. Usually, however, the greater part of the head and neck is white; but there is a black patch in

front of and another above each of the eyes, and there are frequently some long, black hairs on the crown of the head. The terminal third of the tail is generally white.

The typical or long-tailed gymnuras, represented by Raffles's gymnura of Tenasserim, the Malay Peninsula, and Sumatra, and the white gymnura (*G. alba*) of Borneo, are both of the size of very large rats with long, rat-like tails and four pairs of premolar teeth. The short-tailed gymnura (*Hylomys suillus*), of Tenasserim, on the other hand, is more like a mouse in size, with a tail of less than half an inch in length, and of a rusty brown colour, with a length of about five inches.

Raffles's gymnura is stated to make its home beneath the roots of trees; and, from the contents of the stomachs of specimens that have been examined, it has been ascertained that its food consists of different kinds of insects; cockroaches, white ants, and larvæ being apparently favourites. It is distinguished by a peculiarly disagreeable smell of a somewhat oniony or garlic-like nature.

Some years ago there was obtained on Mount Apo, in Mindanao, Philippines, another member of the family which has been described as a new genus and species under the name of *Podogymnura truei*, of which it still remains the sole known example. In point of colour and size True's gymnura is most like the short-tailed species, but has a tail about four times as long, and only three pairs of premolar teeth; all three genera being distinguishable by the characters of these teeth. In *Gymnura*, for instance, the two anterior pairs of premolars are small and practically functionless, while in *Hylomys* this reduction in size extends to the first three pairs; and in *Podogymnura* the first pair has been lost.

Another member of the *Gymnurinae*, representing a genus by itself, inhabits the province of Sze-chuen, in North-Western China, where it was discovered in 1909, and described under the name of *Neotetracus sinicus*. This species, which is the smallest member of the group, is of special interest on account of its forming a connecting link between the *Gymnurinae* and the *Erinaceinae*. In external form, and especially in respect of its well-developed tail, the Sze-chuen rat-shrew approximates to the Philippine True's gymnura, from which, however, it differs essentially in having a dentition of the hedgehog type, the number of the teeth (forty) being the same as in *Erinaceus*; there are likewise vacuities in the bones of the palate recalling those of hedgehogs. The skull is like that of *Hylomys*, but has a much smaller canine; while in the lower jaw the first incisor is followed by five small functionless teeth, after which comes the large third premolar. The general colour of the coat is reddish yellow. This species appears to be related to *Tetracus nanus*, a small insectivore described from an imperfect lower jaw from the Miocene Tertiary strata of France.

Necrogymnurus is an extinct genus of which remains occur in the Tertiary deposits of France belonging to the Oligocene period. This and certain other extinct forms serve to show the antiquity of this group of animals; and, in common with many others, indicate how the early Tertiary fauna of Europe has its nearest representatives in the Malay Archipelago.



THE WHITE GYMNURA

THE SHREWMICE

THE elegant little creatures known as shrews, or shrewmice, as they are popularly termed from their mouse-like form, constitute the second family (*Soricidae*) of the true Insectivora. So like, indeed, are these animals to mice and rats that in popular estimation they are often confounded with them, although they are readily distinguishable by their long and pointed snouts, rounded ears, closely pressed to the sides of the head, and the characters of the teeth.

Though there would be little likelihood of mistaking a shrewmouse for a hedgehog, it is necessary to point out the characters on which naturalists rely in referring these groups to separate families, since the spines of the hedgehogs do not form a characteristic of more than generic importance.

Perhaps the most ready means of determining whether or no an insectivore belongs to the shrewmouse family is afforded by the characters of the first pair of front or incisor teeth. In all shrewmice these teeth are different from the others; those of the upper jaw being long and generally sickle-shaped, with a more or less distinct cusp at the base of their hinder border; while in the lower jaw they are long and project horizontally forwards, sometimes curving upwards at the tips. Moreover, with the single exception of one peculiar African species, which has a rudimentary seventh tooth, the lower jaw of a shrewmouse has only six teeth on each side.

The above features are sufficient to distinguish a shrewmouse from any other insectivore; but a few additional characteristics may also be mentioned. The first and second upper molar teeth of all shrewmice differ from those of hedgehogs and gymnuras in the absence of the fifth or central cusp on the crown. Then, again, the skull of a hedgehog or gymnura has a complete bony bar — the zygomatic arch — running below the socket for the eye to connect the upper jaw with the hind part of the skull, although in one Indian hedgehog this zygomatic arch is incomplete. In a shrewmouse, on the other hand, the bony arch is invariably incomplete beneath the eye, owing to the absence of the cheekbone. A further characteristic feature of the shrewmice is the extreme length and narrowness of their skulls.

With the exception of a few species which have taken to an aquatic life, shrewmice are terrestrial and nocturnal in their habits. They are covered with fur, generally remarkable for its softness; the head is long, with a sharply pointed snout projecting far in advance of the tip of the lower jaw; their eyes are extremely small and bead-like; and the external ears, if present at all, are rounded, and not unlike the human ear in general contour. As mentioned above (page 330), male shrewmice have a gland on the side of the body, producing a secretion which gives rise to the odour exhaled by these animals.

Shrewmice have a more extensive distribution than any other family of Insectivora, and likewise comprise a far larger number of species. They are to be met with throughout the whole of the temperate and tropical regions of Europe, Asia, Africa, and North America, as well as on many of the adjacent islands; one species extending as far north as Unalaska Island in the Aleutian group. From their obscure and retiring habits, shrewmice are difficult of observation; their long and pointed snouts, their extensile form, and short and velvety coat enabling them to pass through the closest herbage, or beneath the carpets of dry leaves in coppices and woodlands, in which situations, as well as in open fields, whether cultivated or in pasture, they seek their food. They are, however, by no means confined to such situations, as, with their relative the water-shrew, they are often met with in marshy and fen districts. On the other hand, one of the Indian muskshrews constantly frequents dwelling-houses. The number of genera, to say nothing of species, of shrewmice is so considerable that it will suffice to notice only some of the more interesting and more important. The genera may be arranged under two groups, according as the teeth are stained reddish brown or are of the ordinary white hue.

TYPICAL SHREWMICE

In addition to their red teeth, the typical shrewmice, as represented by the common European species (*Sorex araneus*), are characterised by the number of the teeth being thirty-two, and by the large size of the ears and the length of the tail; the latter being covered with hairs of nearly, or quite, uniform length. With the

exception of two peculiar species, all these shrewmice are terrestrial; and they inhabit Europe, Asia north of the Himalaya, and North America. Here it may be remarked that the red-toothed shrewmice are quite unknown in Africa south of the Sahara, and are only represented in India and the rest of the Oriental region by a single small genus (*Soriculus*).

The common shrewmouse (pages 338, 349), found abundantly in the British Isles, measures just short of 3 inches in length, exclusive of the tail, and is usually of a reddish mouse-colour above, paler beneath, with the tail somewhat

quadrangular and rather shorter than the body. There is, however, considerable individual variation in colour, specimens being sometimes found banded with white.

Like the mole, the shrewmouse has a wide geographical range, extending from England, through Europe and Asia, to North America, where it is represented by *S. a. personatus*, often regarded as a distinct species. The facility with which this species is able to conceal itself is remarkable. Its food is chiefly insects and worms, supplemented by snails and slugs. In disposition it is so pugnacious that two are rarely



THE SHREWMICE

Photograph by G. Parkin

THE WATER-SHREW

seen together except when engaged in combat; and if two or more are confined together, it will not be long before the stronger kills the less robust. The strong scent with which the shrewmouse is provided probably acts as a preventive against the attacks of some foes, but this is not sufficiently repulsive to deter owls from killing and devouring it. It was long considered that the numbers of dead shrewmice to be found in most gardens during the autumn were due to the attacks of cats, which are known to kill, although they will not eat these animals. The real cause of death, however, is in all probability to be attributed to insufficiency of proper food at that season; and this interpretation is supported by the consideration that it would otherwise be difficult to account for the mortality being confined to one period of the year. Shrewmice hibernate in Europe throughout the winter, and during the spring and summer produce litters of blind and toothless young; the number in each litter being usually five, six, or seven, but occasionally more.

In Ireland the place of the larger species is taken by the pigmy shrewmouse (*S. minutus*), which, although also found in England, is there much more rare. It may be distinguished by its inferior size, and also by the circumstance that the third incisor, the third tooth from the extremity of the upper jaw, is not longer than the fourth. Like its larger cousin, this species has an extensive range in Europe and Asia north of the Himalaya, but does not extend across Bering Strait into America. A still smaller species, belonging to the musk-shrews, inhabits Egypt, and is one of the most minute of all land mammals (page 67).

In marked contrast to the wide range of these species is the restricted distribution of the Alpine shrewmouse (*S. alpinus*), a species of rather larger size than the common shrewmouse, and distinguished by the uniform coloration of the upper and under surfaces of the body. It is only found in the mountains of Central Europe. A variation in size comparable to that existing among the European members of the genus is likewise found in its North American representatives, among which Bendire's shrewmouse (*S. bendirei*) is the largest, and Cooper's shrewmouse (*S. cooperi*) the smallest form, the latter a creature of ceaseless activity and almost insatiable voracity, and not averse from raw meat and even its own kind.

The marsh shrewmouse (*S. palustris*) from the Rocky Mountains, like the swimming shrewmouse (*S. hydrodromus*) from one of the Aleutian Islands, differs from the other members of the genus in having their feet provided with fringes of long hair to aid in swimming.

SHORT-TAILED SHREWMICE

With the exception of the water-shrews, the only other members of the red-toothed section of the family mentioned here are the so-called short-tailed, or earless,

shrewmice (genus *Blarina*) of North and Central America. These are readily distinguished by their short tails and the truncation of the upper part of the ears; some having the same number of teeth as the typical shrewmice, while in others the number is reduced to thirty. Two species of this genus are found in South America—one in Ecuador and the other in Venezuela.

The common short-tailed shrewmouse (*Blarina brevicaudata*) occurs in the Adirondack Mountains in New York State, and is remarkable for remaining active during the whole of the rigorous winters of that region, having been observed running about on the snow when the thermometer indicated 20° below zero. This remarkable habit is correlated with equally marked peculiarities in the diet of this species, which frequents the dense pine forests of the uncultivated districts, as well as the cleared tracts of the inhabited country. This shrewmouse seeks its food both by day and night; and, although the greater part of its life is spent underground, or at least under logs and leaves,



THE PIGMY SHREWMOUSE

Photograph by G. Bolam

and amid roots of trees and stumps, it occasionally makes excursions upon the surface, and has been seen in broad daylight. It subsists on beech-nuts, insects, earthworms, slugs, and mice, and is an undoubted friend to the farmer (pages 330-1).

WATER-SHREW

The water-shrew (*Crossopus*, or *Neomys, jodiens*) is the representative of a genus agreeing with some of the short-tailed shrews in possessing thirty teeth, but distinguished by the small ears not being truncated, by the long tail, and also by the fringes of long hair on the under surface of the latter and on the feet. This shrew, as its name implies, is of thoroughly aquatic habits; the fringes of stiff hair on the tail and limbs being designed to afford aid in swimming. In length, it measures about 3½ inches, exclusive of the long tail. Owing to the fact that while in most specimens the under parts of the body are white, although in others they partake more or less completely of the black hue of the back, it was formerly considered that there were two British species of water-shrew, although later observations have shown that such variations are merely individual.

The water-shrew (page 340), unknown in Ireland, is commonly, but locally, distributed over England and the south of Scotland. It likewise occurs over a large area of continental Europe, whence it extends eastwards into Asia as far as the Altai range. In the water these graceful little creatures are as much at home as water-rats or beavers; and in clear streams may often be observed during the daytime diving or running along the bottom, and turning over the pebbles with their sharp noses in search of freshwater shrimps, which appear to constitute their favourite food. In addition to these crustaceans, water-shrews devour many



SPIDER MUSK-SHREWS

kinds of aquatic insects or their larvæ, while it is also probable that they feed on the spawn or fry of minnows and other small fishes. There are instances on record where water-shrews have been found feeding on the flesh of larger animals, which they have found dead.

The swimming of the water-shrew, writes Prof. Thomas Bell, seems to be "principally effected by the alternate action of the hinder feet, which produces an unequal or wriggling motion; it makes its way, however, with great velocity, and as it swims rather superficially, with the belly flattened, the sides, as it were, spread out, and the tail extended backwards as a rudder, it forms a very beautiful and pleasing object, moving on the calm surface of a quiet brook, or diving, in an instant, after its food, its black, velvety coat becoming beautifully silvered with the innumerable bubbles of air that cover it when submerged; and on rising again the fur is observed to be perfectly dry, repelling the water as completely as the feathers of a water-fowl. When submerged, the ear is nearly closed by means of three little valves."

The burrows of the water-shrew are constructed in the banks of the pond or stream in which it dwells; and, if disturbed from the protection thus afforded, the creature plunges forthwith into the water to seek safety in what must be regarded as its native element. The female gives birth to the young in the burrow, the number in a litter varying from five to seven or eight.

In addition to its darker colouring and structural differences, the water-shrew may be distinguished from the common shrewmouse by its stouter and somewhat depressed muzzle. The red stain on the teeth is, moreover, much less decided than in the latter; and, indeed, when the teeth have been much worn by long use, tends more or less completely to disappear.

The water-shrews of the plains of the Continent are distinguishable from those inhabiting Great Britain, Scandinavia, and the mountain ranges of Europe, and are therefore entitled to rank as separate local races. The former are relatively large, with three distinct colours; the flanks showing a tint intermediate between the black of the back and the white of the under parts. The latter, on the other hand, are duller and more uniformly coloured. The name of the British race is *Crossopus*, or *Neomys, fodiens ciliatus*.

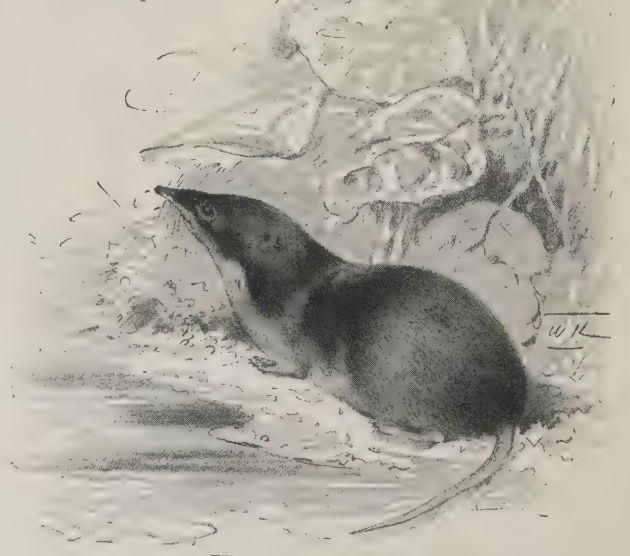
MUSK-SHREWS

The musk-shrews, which include by far the largest representatives of the entire family, are the first members of the group characterised by their white

teeth. No representatives of the musk-shrews occur in Britain, although the spider musk-shrew (*Crocidura russulus*), and the European musk-shrew (*C. suaveolens*) occur on the continent of Europe. These shrewmice, which are of terrestrial habits, have either thirty or twenty-eight teeth, well-developed ears, a long tail, and a coat of mingled long and short hairs. The eyes are very small, and placed nearer to the ears than to the tip of the nose. Each side of the body is furnished with a gland, sometimes absent in the female, secreting the musky product from which these shrews derive their popular name.

A very large number of species of musk-shrews has been described; the range of the genus embracing Southern and Central Europe, Africa, and Asia. The species with the widest range is the spider musk-shrew, which is found from North Africa and Central and Southern Europe to Central Asia, extending as far north as North-Eastern Siberia, and as far south as Ladak. It belongs to the typical group of the genus, characterised by having only three small conical teeth behind the large first upper incisor, and is a comparatively small species, of about 3 inches in length, exclusive of the tail. This shrewmouse frequents cultivated grounds in Europe, not infrequently entering houses; and preys on insects, worms, and the young of the smaller mammals and birds. The young are born in summer, and vary from five to as many as ten in number.

The European musk-shrew (*C. suaveolens*) is the second representative of the genus in Europe. It belongs to a group characterised by the presence of four, in place of five, small conical teeth, of which the hindmost is very minute, behind the first upper incisor tooth. This group, which is numerously represented in India, includes the largest of all shrews, and those most strongly scented with the characteristic musky odour. The best-known, and at the same time the largest, of these Indian species are the brown musk-shrew (*C. murina*) and the grey musk-shrew (*C. caerulea*), the latter of which is commonly termed



THE WATER-SHREW

by Anglo-Indians the musk-rat. Both these species have nine teeth on each side of the upper jaw, and their length may be as much as 6 inches, exclusive of the tail. The hair of the former is of a brownish tinge on the body and feet, but in the latter it is more of a slaty hue, while the feet are flesh-coloured or yellowish white. In other respects these two species are very closely allied; but while the brown musk-shrew is found as a rule in woods (although it will occasionally enter buildings), the grey musk-shrew generally, if not invariably, haunts human habitations. It has accordingly been suggested that the latter is merely a peculiar variety of the former. The grey musk-shrew is nocturnal, and a common visitor to Indian houses. Articles impregnated with its musky secretion become utterly useless. There has, however, been much exaggeration as to the penetrating power of this scent, as in the well-known but absurd story that wine or beer becomes impregnated with a musky flavour if one of these shrewmice run over the outside of the bottle containing the liquor. In addition to its favourite cockroaches and other insects, the grey musk-shrew will also readily devour meat, and accounts are on record of an attack made by one on a frog, and by another on a snake.

Other Indian musk-shrews belonging to the same group of the genus, such as Blyth's musk-shrew (*C. fuliginosa*), have but eight teeth on each side of the upper jaw, or the same number as in the European spider musk-shrew (*C. russulus*).

BURROWING SHREWS

The burrowing shrews (genus *Anurosorex*) are small mole-like creatures, inhabiting North-Western China and Assam, where they are apparently rare. They are characterised by their large heads, minute eyes, the absence of ear-conchs, a very short tail, and thick velvety fur. The total number of teeth is twenty-six, of which there are seven on each side of the upper jaw. Of the two species, the one from Assam measures about 3 inches in length, exclusive of the stumpy tail, and is of dark slaty colour, with a tinge of brown. The interest attaching to these shrews arises from the circumstance that their structure is indicative of burrowing habits like those of the mole, although nothing is known on this point from actual observation.

SWIMMING SHREWS

Although the name swimming shrews (genus *Chimarrogale*) would be equally applicable to the water-shrews and the latter name to the members of the present genus, yet it is convenient to take the two terms with the signification here given. The swimming shrews, of which one species (*Chimarrogale himalayica*) is found in the Himalaya and Mount Kina Balu, in Borneo, and another (*C. platycephalus*) in Japan, closely resemble the water-shrews in general appearance, but are distinguished by the teeth being entirely white, and likewise by being twenty-eight instead of thirty in number. These shrews have small external ear-conchs, broad scaly feet, with a fringe of coarse white hairs on their margins and on the sides of each toe, and a long tail fringed with similar hairs. The individual toes, however, are not connected by webs.

The Himalayan swimming shrew has slaty grey fur above, with the tips of the hairs blackish brown. One female measured a little over $4\frac{1}{2}$ inches in length, exclusive of the tail, the length of the latter being 3 inches; but it is probable that other individuals are considerably larger. This shrew inhabits the south-western portions of the Himalayan range, at elevations from three thousand to five thousand feet above the sea level, and is also found in the hills of Northern Burma. It inhabits the banks of streams, and doubt-



WEB-FOOTED SHREWS

less swims quite as well as the European water-shrew. It has been observed plunging into the water, and running over the stones on the bed of a stream. It feeds on aquatic insects and their larvæ, as well as on tadpoles and the smaller fishes and their fry. The assumption of aquatic habits by members of both the red-toothed and white-toothed sections of the shrewmice is an interesting example of how animals belonging to different groups may acquire almost exactly similar external characters, as being essential to their particular mode of life. Other species of these swimming shrews are found in China.

WEB-FOOTED SHREW

A still further modification for the purposes of an aquatic life is exhibited by the web-footed water-shrew (*Nectogale elegans*) of North-Western China, in which not only are the feet and tail fringed with hairs, but the external conchs of the ears are wanting, and the toes completely joined by webs, while the soles of the feet are furnished with large disc-like pads. The web-footed shrew has a tail of 4 inches in length, while the length of the head and body is but just over $3\frac{1}{2}$ inches. The fur, which is extremely dense and soft, and evidently adapted to withstand the icy cold of the North China rivers, is rich dark brown colour above, with the longer hairs glistening white, while the chin and throat are whitish, and the belly is light brown. It does not appear that this shrew has ever been seen by Europeans disporting in the waters of its native streams. From its structure it may, however, be confidently inferred that it is more thoroughly aquatic than any other member of the family; and it is probable that the disc-like pads on the soles of the feet act as suckers, and thus enable the animal to cling to the surfaces of smooth pebbles or rocks during its sojourn beneath the water.

THE MOLE FAMILY

THE European desmans and the more widely-spread moles are the best-known representatives of a family (*Talpidae*) which, while allied in many respects to the shrewmice, possesses characters of sufficient importance to justify its separation. In the first place, the skull in all members of the family is distinguished from that of the shrewmice by having a slender zygomatic arch connecting the upper jaw with the region of the ear. Then, again, on the under surface of the hind part of the skull the so-called bulla of the internal ear is represented in the shrewmice merely by an open ring, but in the desmans and moles it has a complete bladder-like form. Further, the first incisor tooth of both jaws in the present family is of a normal type, and never assumes the peculiar form characteristic of all the shrewmice.

Most of the members of the mole family are of fossorial, or digging, habits, although a few are more or less completely aquatic; and others are cursorial, or runners. All have long shrew-like skulls, and small eyes and ears; while in most cases the fore limbs are placed very far forward on the body, and are more or less specially modified for the purpose of digging in the ground. The family, although by no means so numerous in species as the shrewmice, is a comparatively large one, containing at least eight distinct generic modifications. It is confined to the Northern hemisphere, where it is widely distributed over the temperate regions of Europe, Asia, and North America.

DESMANS

The strange-looking desmans (genus *Myogale*), of which there are two species, are aquatic Insectivora belonging to a section of the family characterised by the fore limbs not being specially modified for the purpose of digging, and thus forming a connecting link between shrewmice and moles. This absence of special modification is exhibited by the bones of the skeleton of the fore limb, in which the collarbone (clavicle) and the arm-bone (humerus) still retain a distinctly elongated form, while there is no additional bone in the fore foot.

Desmans are provided with the full mammalian number of forty-four teeth, and are further characterised by their completely webbed feet, their long trunk-like snout, which projects far in advance of the upper lip, and the elongated and scaly tail. The Russian desman (*Myogale moschata*) is

considerably the larger of the two species, its total length being about 16 inches, of which some 6½ are occupied by the tail. The fur is dense and thick, like that of an otter, with the outer portion formed of long, stiff hairs, and the under coat soft and woolly. Above, it is full reddish brown, and beneath ashy grey, with a silvery lustre when viewed in certain lights. The first incisor tooth in each jaw is very large and powerful, the upper one being somewhat chisel-shaped.

The tail is laterally flattened. This species inhabits the banks of streams and lakes over a large portion of South-Eastern Russia, dwelling in holes after the manner of a water-rat, and being as much at home in the water as an otter. Indeed, the greater part of the creature's time appears to be spent in that element; the burrow, which terminates in a large chamber above the level of the water, being mainly used as a resting and breeding place. Its chief food consists of aquatic insects and their larvæ, although it probably also devours small fishes. Insects and larvæ are sought after by means of the proboscis-like snout, which is used to probe under stones and in chinks and hollows. A sharp hissing sound is given forth when the animal is irritated or disturbed. The specific name of the desman is derived from the musky odour produced by the secretion of a large gland situated beneath the rest of the tail; this taint rendering its flesh uneatable. Owing to its beautiful fur, which is not unlike that of the otter or beaver, the Russian desman is largely hunted by the peasants of the regions where it is found; early autumn being the season when the fur is in the finest condition.

Although now confined to the steppes of South-Eastern Russia, the Russian desman once extended as far westwards as the British Isles, its fossilised remains having been obtained from the so-called Forest Bed of the Norfolk coast, which was deposited during the epoch immediately preceding the Glacial period. Remains of extinct species of the genus have also been obtained from the Tertiary deposits of the Continent as far back as the Oligocene period.

Far smaller than the Russian species is the Pyrenean desman (*M. pyrenaica*), found on both the French and Spanish flanks of the mountain range from which it derives its name. In total length this animal does not exceed ten inches, of which about half is formed by the tail. It is, however, also distinguished from its larger relative by the greater proportionate length

of its proboscis, and likewise by the tail being perfectly cylindrical. In mode of life the two species seem to be very similar, although it has been stated that the smaller one has a more marked preference for a diet of fish.



RUSSIAN DESMANS

MOLE-SHREWS

Brief notice will suffice for the curious mole-shrews, which closely connect the moles with the shrewmice. The true mole-shrews, of which there are two species, constitute the genus *Urotrichus*, and are respectively found in Japan and North America. They have thirty-six teeth, of which 2 are incisors, and either 7 or 8 cheek teeth on each side; and they are further characterised by their broad and unwebbed fore feet and fossorial habits. They are mole-like in appearance, and of small size. The Szechuen mole-shrew (*Uropsilus soricipes*) is the sole representative of a distinct genus, differing from the last in having only thirty-four teeth, a narrow fore foot,

THE MOLE FAMILY

and a naked and scaly tail. In habits it is cursorial; and while in external appearance it resembles a shrew-mouse, its skull and teeth are like those of a mole. Its general colour is slaty grey. This species was first obtained in the Moupin district of Sze-chuen.

WEB-FOOTED MOLES

The web-footed moles (genus *Scalops*) of North America form the first representatives of the second section of the family, characterised by having the collarbone (clavicle) and arm-bone (humerus) so shortened and widened as to have lost all resemblance to the ordinary form, and also by the presence of an additional sickle-shaped bone on the inner side of the fore foot, next to the thumb, both these features being intimately connected with the purely fossorial habits of all the members of this section of the family.

All moles, whether they belong to the New or the Old World group, are characterised by their peculiar form, so admirably adapted to their mode of life. All have the fore paws naked, and of enormous width and strength; while in all there are no external ear-conchs, and the small and useless eyes are deeply buried beneath the fur, and are often further protected by an investing membrane. These animals are also characterised by the extreme thickness and density of their short, velvet-like fur, which can be brushed either way, and to which no fragments of the soil through which the burrows are driven ever adhere. Like the New World moles, the web-footed moles are distinguished from their cousins of the Old World by the fact that the first incisor tooth in the upper jaw is of much larger size than the second. The special characteristics of the web-footed moles are that they have only thirty-six teeth, of which $\frac{2}{3}$ are incisors, $\frac{1}{3}$ canines, and $\frac{1}{3}$ cheek teeth, and the hind feet are webbed, and that the tail is short and nearly naked.

The common web-footed mole (*Scalops aquaticus*) received its specific name on account of its webbed hind feet, which led to the very natural inference that it was a swimming animal. But this is a complete misnomer, for not only is this mole not known voluntarily to swim, but in the selection of its haunts it shows no preference for the vicinity of water, but manifests a contrary tendency. Its home is underground, its whole life being spent beneath the surface; and its food consists almost entirely of worms, grubs, and ants, and other insects that live in the earth and under logs and stones. It is regarded as an enemy of the farmer, and destroyed whenever opportunity affords; because, notwithstanding that it subsists on insects that injure crops, in procuring these it disfigures garden paths and beds by the ridges and mounds of soil that mark the course of its subterranean galleries, and loosens and injures plants in probing for grubs among their roots. The nest of this mole is half a foot or more below the surface, and from it several passages lead away in the direction of its favourite foraging-grounds. These primary passages gradually

approach the surface, and finally become continuous with, or open into, an ever-increasing multitude of tortuous galleries, which wind about in every direction, and sometimes come so near the surface as barely to escape opening upon it, while at other times they are several inches deep. Along the more superficial of these horizontal burrows the earth is thrown up in the form of long ridges, by which the animal's progress can be traced. The distance these moles can travel underground in a short time is almost incredible. They have been known in a single night after rain to excavate a gallery several yards in length, while a fresh one has been traced nearly one hundred yards. The only

method by which a just appreciation of the magnitude of this labour can be estimated is comparison, and computation shows that in order to perform equivalent work a man would have to excavate in a single night a tunnel thirty-seven miles long, and of sufficient size easily to admit the passage of his body.



A MOLE WALKING
Photograph by Edward Connold

HAIRY-TAILED MOLES

The hairy-tailed moles, of which several species inhabit the United States, form a connecting link between the web-footed and the star-nosed moles, having the general ex-

ternal appearance of the former, but the same number (forty-four) of teeth as in the latter. The habits of the common hairy-tailed mole (*Scapanus americanus*) appear similar to those of the web-footed moles, both inhabiting dry meadows in preference to the swampy ground affected by the star-nosed mole. The mounds of the hairy-tailed moles, however, do not contain the central and surface openings of those of the web-footed moles; neither do the former animals indulge in the midday excursions so characteristic of the latter.

STAR-NOSED MOLE

The last of the three groups of North American moles is represented only by a single species, the star-nosed mole (*Condylura cristata*), so called on account of the peculiar ring of ribbon-like appendages surrounding the end of the muzzle, in the middle of which are situated the nostrils. In addition to this feature, this curious mole is characterised by the tail being nearly as long as the body, and also by the fact that the bones of the terminal joints of the fingers are not cleft at their extremities, as they are in the Old World moles. Like the latter, the star-nosed mole possesses the typical number of forty-four teeth. In length this species measures about 5 inches, exclusive of the tail.

The food of this mole consists entirely of earth-worms and insects, and its habits are very similar to those of the web-footed mole, although it does not apparently make such extensive excavations, and the hillocks thrown up from the runs are of larger size. In gardens and arable land these moles tunnel near the surface, throwing up ridges of loose earth along the line of their tunnels, but in pasture land they work at a lower level. In both these respects they resemble the ordinary European mole, with which they also agree

in that, during the late autumn, when the surface of the ground becomes frozen, they follow the worms downwards until a level is reached where the frost has not penetrated. By following the ridge of loose earth which marks the progress of one of these moles in a garden, and quickly sinking a spade in the creature's path, a few inches in advance of the moving earth, it is often possible to turn a specimen out upon the surface. So quickly, however, does the animal pass through the soft soil of a garden, that the spade, although aimed several inches in front of the moving earth, will sometimes cut it in two. Although the precise function of the peculiar disc of tentacles round the muzzle is not yet definitely ascertained, it is probable that it acts as a sensitive organ of touch to aid its owner in discovering the whereabouts of the worms and insects encountered during its subterranean wanderings. In new-born young these tentacles are so small as to be scarcely perceptible.

TYPICAL MOLES

The Old World moles may be distinguished from all their North American cousins by having the first upper incisor tooth scarcely larger than the second. With the exception of a single species from North-Eastern China, all the Old World moles may be included in the genus *Talpa*, of which the typical representative is the common European mole (*T. europæa*). The numerous members of this genus are distributed over temperate Europe and Asia, two of the Asiatic species being found to the south of the Himalaya. As a rule, there is the typical number of forty-four teeth, but a few of the species have not quite so many, owing to the loss either of the lower canine tooth or of the first upper premolar; while in one species the first premolar is wanting in both jaws. All are characterised by the width of the fore foot.

It is remarkable that as the European hedgehog differs from most other species of its genus, so the European mole is distinguished from its congeners by the absence of a membrane covering the eyes. All, or nearly all, these moles are black in colour, with a more or less pronounced greyish lustre when viewed in certain lights; but pied, buff, or white varieties are not very uncommon. The naked feet are flesh-coloured. The different species show considerable variation as regards the relative length of the tail; and whereas in the European mole the length of the head and body is about 5 inches and that of the tail 1 inch, in the Himalayan short-tailed mole (*T. micrura*) the naked tail is less than a quarter of an inch in length, and is completely concealed among the fur of the body.

The ordinary European mole is remarkable for its wide geographical distribution, ranging from England in the west, through Asia north of the Himalaya, and extending northwards as far as the Altai Mountains, to Japan. Like its cousin, the common shrew-mouse, it is unknown in Ireland. The "runs" of the European mole are very similar to those of the American moles, but the central chamber, or

dwelling-place, is of a more complex structure. With regard to the situation of the breeding-hillock, or fortress, this is generally in the open field, although it may occasionally be placed in a hedge-bank, but only when there is a ditch alongside. Indeed, the proximity of water seems to be the main factor in determining the position of the structure. Now and then a fortress may be found under a tree, but such a position is probably accidental. The more or less complicated galleries, with the exception of one "bolt-hole," have no reference to premeditated escape, and are the outcome of the work of excavating the nest-cavity and piling up the superincumbent mould.

When the site for the fortress has been fixed on, a circular cavity is excavated for the reception of the nest at a depth of from two to six inches below the surface of the ground, except in the case of boggy soil or in situations liable to be flooded, when the nest is often made above the original ground-level. The easiest way to dispose of the excavated soil is to push it up to the surface, and for this purpose a tunnel is constructed, and in such a case the whole mound is made by this tunnel.

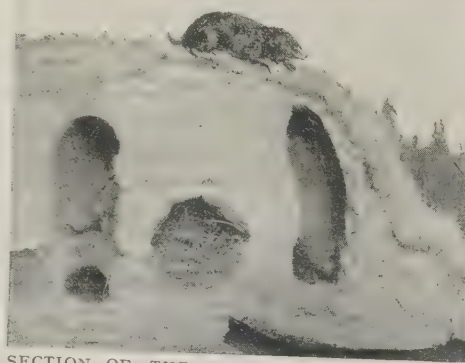
"When this superincumbent earth," writes Mr. L. Adams, "has reached an inconvenient height, another tunnel is made, sometimes from another part of the nest-cavity, but more often sideways from the first upward tunnel. All this takes time, and the mole meanwhile makes fresh runs from the fortress, the seat of its labour, in various directions in search of food. Much of the earth displaced in making these fresh runs falls into the nest-cavity, and has to be disposed of in the same way as before, and also the soil displaced in making the bolt-run and the down-shaft, where this latter occurs. Now, the tunnel (or tunnels) leading upwards from the nest-cavity becomes larger and larger, winding round the surface of the growing fortress. When this removal of earth becomes too fatiguing, on account of the length of the tunnel, the mole will often begin to make new tunnels from runs close to the end of the

fortress. Sometimes these new runs break into those leading from the nest-cavity, but not often; usually they lie above them." It thus appears that the tunnels are for two distinct purposes. First, we have those formed for ejecting earth from the nest-cavity and bolt-run, which are generally in the form of a corkscrew ascending from the nest, and often with blind divergent terminations; and, secondly, tunnels unconnected with the nest-cavity, but traversing the fortress from external runs, through which earth has been carried to heap over the nest.

Except when in marshy soil, nearly every fortress has a bolt-run, which leads upwards from the bottom of the nest, and thus outwards, without connection with the other tunnels. More rarely a down-shaft, which may be nearly a yard in length, descends obliquely from the nest. The use of these down-shafts is not apparent. Presumably, in them the collections of paralysed worms, supposed to be stored up as food, have been found. Such collections of worms, however, may be accidental. The nest-cavity, which is worn smooth by friction, contains



BONES OF THE FORE LIMB OF A MOLE
Photograph by D. English



SECTION OF THE INSIDE OF A MOLE-HILL

TYPICAL MOLES

a ball of grass or leaves, or a mixture of both, by which it is completely filled. In the case of the English species, at any rate, no fur from the mole's body is used in lining the nest. Apparently a nest is never used for more than one season, but two or even three nests, generally one above the other, may be found in some fortresses, of which the newest is alone in use. In all cases it appears that the female makes a fortress and nest of her own in which to breed, this being usually less complex than that of her partner, and without a bolt-run. Whether the female inhabits the same fortress as the male before breeding time is doubtful, and it is not improbable that moles are polyandrous. The female produces only a single litter annually. The young are usually born between the middle of April and the latter part of June, after a gestation of four weeks; the number in a litter varies from two to six, three or four being usual. The number of teats in the female is eight.

According to the observations of Mr. R. Service, there is considerable individual variation in the size of moles. The largest male he obtained measured $7\frac{3}{4}$ inches in length, but an inch less than this still indicates a large individual; $5\frac{1}{2}$ inches is about the average for the female, the maximum observed being $6\frac{1}{4}$ inches. Great variation in the tint of ordinary black individuals of the species is also noticeable. As regards more striking colour-variation, the commonest abnormality is cream colour, ranging from pale cream to deep rusty yellow, but a comparatively common phase shows a patch of yellow or rufous on the breast or abdomen, or on both. In some instances the light area extends over the whole of the under parts, while in others it takes the form of a narrow or broad line down the middle of the same region, but in all individuals the light area has a longitudinal extension, and it is always sharply defined from the dark parts. A really white mole is very rare. There seems little doubt but that the tendency to colour-variation runs in particular families.

Since the voracity of the mole is proverbial, and its food consists exclusively of earthworms, insects, and their larvæ, its visits ought to be welcomed alike by the farmer and the gardener. As a matter of fact, however, the mole has an awkward habit of driving its tunnels below the drilled rows of young farm and garden crops, by which not only are the roots of the plants disturbed, but the whole row may be dried up. Moreover, it appears pretty certain that field-mice take advantage of runs driven in such localities as convenient points from which to make inroads on the sprouting seeds or the roots of the young plants. Then, again, in addition to the unsightliness of a host of mole-hills in a garden, such elevations are inconvenient in a field of standing grass, as they impede the process of mowing. For these and other reasons farmers and gardeners unite in a war of extermination against the mole, although in many respects its visits are a distinct advantage to its destroyers.

It is well known that male moles are more numerous than females, and a writer in "The Field" states that a

family "of moles appears to consist of five members, in the proportion of four males to one female—this as a rule, though with many exceptions. In the course of my experience I have never caught more than five in succession in the same run; and this, therefore, appears to be the limit." Moles have the habit of feeding at regular hours during the day, and may be found at work at eight, twelve, and four o'clock.

In regard to mole-catching, it is mentioned that, "when setting a trap in light crumbling soil, as in a flower-bed, care should be taken to remove only sufficient earth to allow of the trap being put in, and the hole leading each way should be carefully cleared, so as to allow the mole a free passage, or he will infallibly dive underneath your trap. A piece of slate put at the bottom of the run is a good preventive of this kind of thing." Like their North American relatives, moles swim well, and take to the water readily.

Savi's mole (*T. cæca*), from South Europe, differs from the common species in having a membrane over the eyes, and is thus completely blind; while the Roman mole (*T. romana*) is distinguished from both the other European species by its larger teeth.

The short-tailed mole (*T. brachyura*), abundant near the Himalayan station of Darjiling, at elevations of from five thousand to eight thousand feet above the

sea-level, inhabits the deep bed of black vegetable mould found wherever the original forest has not been destroyed. This mould contains earthworms and larvæ of insects, the chief food of moles, in abundance. The runs often proceed from the base of one great oak to that of another, but are not marked by mole-hills like those of the European species.

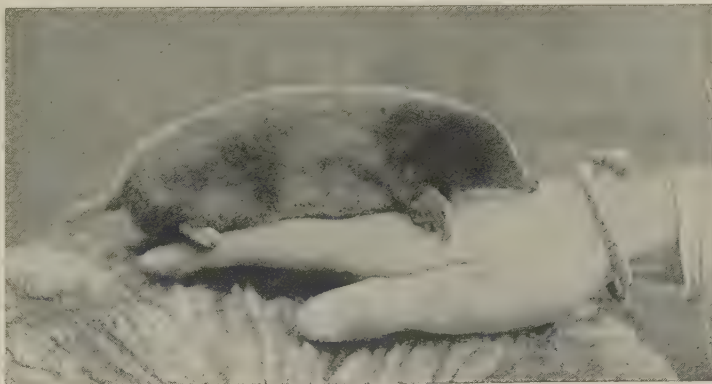
The ordinary Japanese mole (*Talpa wogera*) is referred

by many naturalists to a separate genus, under the designation of *Mogera*, a designation as barbarous as it is un-descriptive.

Fossil moles are found throughout the Tertiary strata of Europe from the Oligocene deposits of Central France; some of these extinct species belonging to the existing genus *Talpa*, although others, on account of the arm-bone (humerus) being rather less expanded, have been regarded as representing a distinct genus, *Protalpa*.

The occurrence of these Tertiary moles is interesting, as they show how extremely ancient must be the insectivorous type of mammals, since even at those early epochs the remarkable structural peculiarities distinctive of the skeleton of the existing members of the group had already attained their nearly complete development.

This notice of the mole family may conclude by a reference to the yellow-tailed mole (*Scaptonyx fuscicaudatus*) of North-Eastern China. This mole, which has only two pairs of lower incisor teeth, and consequently but forty-two teeth altogether, differs from the true moles in the considerably lesser width of the fore feet, and thus approaches, so far as this particular feature is concerned, the mole-shrews already described (page 342).



THE MOLE

Photograph by Coles Finch

THE TENRECS

WITH the curious *tenreco*s, constituting the family *Centetidae*, we reach the first member of a group of Insectivora, comprising four families, which differ from all those yet noticed in the characters of their upper molar teeth. In all the preceding families the upper molar teeth have broad crowns, with cusps arranged somewhat in the form of the letter W. On the other hand, in those remaining for consideration, the crowns of these teeth are narrow, and carry only three cusps, arranged in the shape of the letter V. These cusps, or tubercles, thus form a triangle, with the apex directed inwardly; and this type of molar tooth is consequently known as the *tritubercular*. Such a distinction may seem of slight importance. This, however, is by no means the case, since nearly all the earlier mammals had tritubercular molar teeth, from which it may be inferred that mammals retaining them in their primitive form belong to an ancient stock. The tritubercular type in its simplest and most characteristic form, occurs among existing families only in the golden moles. Possibly the tricuspid teeth of Insectivora are a new development.

From this and other structural peculiarities it may be taken as certain that the Insectivora of the present and three following families belong to a much lower type of organisation than those already mentioned; this being borne out in a remarkable manner by their geographical distribution. Of the Insectivora with tritubercular molar teeth, the present and largest family is restricted to Madagascar and a few of the neighbouring islands; a second is found both in Madagascar and Africa; the third is solely African; while the fourth is confined to the West Indies. All the tenreco's are characterised by these long skulls, which are not constricted between the eyes, and have no zygomatic arch below the socket for the eye to connect the upper jaw with the region of the ear, while the so-called tympanic bulla is in the form of a simple ring.

The great tenrec, scientifically known as *Centetes caudatus*, is readily recognised by its comparatively large size and the total absence of a tail, from which feature it derives its name. It is the sole representative of its genus. Adult males attain a length of upwards of 16 inches, and are some of the largest of insectivores. The body is covered with a mixture of flexible spines, bristles, and hairs; but while in the young the former are arranged in longitudinal lines down the back, in the fully adult state they are restricted to a kind of collar round the upper side of the neck. Spines, bristles, and hair are yellowish or whitish towards the tips, and brown near the middle, so that the general colour of the head and body is a kind of yellowish brown. When fully adult, the tenrec has forty teeth, of which on each side $\frac{2}{3}$ are incisors, $\frac{1}{4}$ canines, and $\frac{1}{4}$ cheek teeth. The tusks, or canines, of the males are very long and sharp, and capable of inflicting a severe

wound. The most remarkable peculiarity connected with the dentition, however, relates to the upper cheek teeth. In a middle-aged tenrec there are six cheek teeth behind the canine on each side of both jaws; three of these belonging to the premolar, or those preceded by milk teeth, and three to the molar series, which have no such predecessors. Very late in life, however, a small fourth molar appears in the upper jaw behind the other three. Considering that no other mammal with teeth divided into distinct series has four upper molars as a normal condition, except the

African long-eared fox, this is a very remarkable feature. The female tenrec produces an unusually large number of young at a birth, one instance being recorded when so many as twenty-one young were brought forth at a single birth, although fifteen or sixteen is the common number.

These animals—the habits of which are strictly nocturnal—are chiefly found in the mountains of Madagascar, where they inhabit the low covert afforded by ferns and bushes. Earthworms form a large proportion of their diet, which is, however, extensively supplemented by in-

sects; the worms and insects are rooted out from their holes and hiding-places by the flexible snout with which the tenrec is furnished. During one season of the year tenreco's become torpid for a long period, burrowing deep holes in the ground about May or June, from which they do not emerge till the following December. Whether this is to avoid a season of drought, when their natural food is difficult to procure, does not appear to be ascertained. Like other animals which enjoy a periodical rest, the tenreco's at the beginning of their torpor are in a fat condition, and are then much sought after by the natives as an article of food; the whereabouts of their burrows being usually revealed by a heap of dirt or debris covering the entrance. Tenreco's have been exhibited at the London Zoological Gardens, where they displayed the remarkable habit of opening their mouths so widely as to show much of the throat.

STREAKED TENRECS

The streaked tenrec (*Hemicentetes semispinosus*) and its relative *H. nigriceps* represent a genus distinguished from the preceding by having three, instead of two, upper incisor teeth, and probably only three upper molars; as well as by certain peculiarities in the structure of the skull and the smaller size of the canine teeth, which are scarcely larger than the incisors, and cannot properly be termed tusks. The streaked tenrec is an animal of about the size of a mole, and derives its name from the longitudinal streaks of black and yellow with which the body is ornamented. In this and the allied species the longitudinal rows of spines on the back, which disappear in the adult of the great tenrec, are retained throughout life.



THE TENREC

THE SOLENODONS

HEDGEHOG-TENRECS

The little animals known as hedgehog-tenrecs are so like small hedgehogs in general appearance that they might readily be taken for members of the same family. Like hedgehogs, they have the whole of the upper surface and sides of the body covered with short parti-coloured bristles; and they are also furnished with a short tail. Of more importance as a generic character is the fact that there are only two incisor teeth on each side of both the upper and lower jaws. Although it is probable that these animals can to a certain extent roll themselves up into a ball, yet from the feeble development of the layer of muscle beneath the skin, it seems likely that this cannot be done so completely as in the hedgehogs. Since it cannot be considered that hedgehog-tenrecs are in any way nearly related to hedgehogs, it is somewhat remarkable that both should have developed such exactly similar spines, which are used for defensive purposes in the same manner. The common hedgehog-tenrec (*Ericulus setosus*) is about two-thirds the size of the European hedgehog, and has thirty-six teeth. Telfair's tenrec (*E. telfairi*) is considerably smaller, with only thirty-four teeth, owing to the absence of the first pair of premolars in the upper jaw.

LONG-TAILED TENRECS

Certain small mouse-like animals from Madagascar, each having forty teeth, are distinguished from the

preceding members of the family by the absence of spines mingled with the fur, and also by the great length of the tail. In one of the species (*Microgale longicaudata*) of these long-tailed tenrecs the length of the tail is double that of the head and body—a proportion only equalled among the pangolins in the order Edentata. Of the forty teeth, $\frac{3}{4}$ are incisors, $\frac{1}{4}$ canines, and $\frac{1}{4}$ cheek teeth on each side of the jaws.

WATER-TENRECS

Another and little-known member of the family, the water-tenrec (*Limnogale mergulus*), is interesting on account of its aquatic habits, in which it is quite unlike all its relatives.

RICE-TENRECS

The last members of the tenrec family are the small mole-like animals known as rice-tenrecs, distinguished by the extreme shortness of their tails and likewise by their burrowing habits. The four-toed rice-tenrec (*Oryzorictes tetradactyla*) is peculiar in having only four toes on the fore feet, of which the three innermost ones are armed with powerful claws for digging. A second species (*O. hova*) has five front toes; but both agree in having long, trunk-like snouts. These animals are a great pest to the agriculturists of Madagascar, owing to the damage they inflict on the rice crops by burrowing in the earth beneath the young plants in search of worms and insects.

THE SOLENODONS

STRANGE as it may seem that the nearest relatives of the tenrecs of Madagascar should be found in a region so far removed from that island as the West Indies, yet the two species of solenodons (family *Solenodontidae*) really occupy this position; although in the form of the incisor, canine, and premolar teeth they approximate very closely to the desmans.

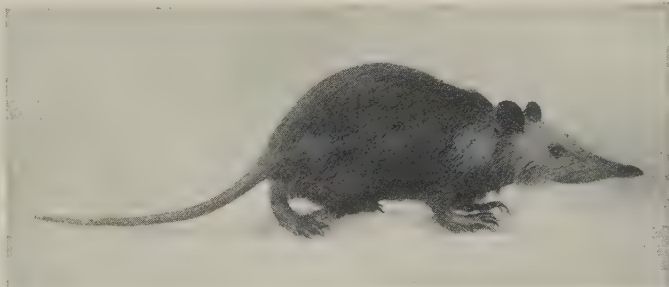
Solenodons have a total of forty teeth, corresponding serially with those of the long-tailed tenrec, and they are distinguished from the *Centetidae* by the fact that the skull is somewhat narrowed between the eyes, and also by the teeth being entirely confined to the region of the groin, instead of extending on to the breast, as in other members of the order. The snout is long, cylindrical, and trunk-like, with the nostrils situated on each side of its extremity; the tail is naked, cylindrical, and of considerable length, and the toes, especially those of the fore feet, are armed with powerful curved claws. The fur covering the body is long and coarse.

The Haytian solenodon (*Solenodon paradoxus*) is restricted to the island of Hayti, and was the first known of the two species. It may be compared in size to a small rabbit, the head and body measuring about 12 inches, and the tail about 8 inches. The head and upper parts are brown, becoming blackish behind and on the thighs; while the sides of the head and under parts are lighter in colour. The Cuban solenodon (*S. cubanus*) is distinguished by the whole of the head, neck, and chest being tawny, or yellowish, while the remainder of the upper part and the sides of the body are dark blackish brown. The nature of the fur is also somewhat

different from that of *S. paradoxus*. This species is found in the mountains of the southern and western portions of Cuba, and issues from its diurnal resting-place during the late afternoon and early evening to spend the night in search of food. From the readiness with which, when in captivity, it will tear in pieces meat that is offered to it, it may be inferred that in the wild state its food is not restricted to insects; this being confirmed by the following observations on the Haytian species.

The species inhabiting Hayti was reported to be extinct, and in order to find out whether any specimens still survived, an American naturalist, Mr. A. H.

Verrill, made an expedition to Hayti. After much trouble, it was ascertained from the natives that the creature is still to be found in certain parts of the interior of the island; but, nevertheless, only a single specimen—a female—was obtained, which died the day following her capture, after having given birth to three naked offspring. This specimen



THE CUBAN SOLENODON

showed that the Haytian solenodon differed from the Cuban species in the more flexible snout and naked rump, as well as in size and colour. Its scarcity is due to the introduction of the mongoose, which will probably lead to its extermination. The creature has the habits of a small pig, digging in soft ground with its flexible snout in search of the insects, grubs, and reptiles which form its chief food. Fruit and other vegetable substances are also eaten. Solenodons are strictly nocturnal. When hunted with dogs, they thrust their heads into the first hole they see, leaving the body exposed, and are thus easily captured.

THE OTTER-SHREWS

THE curious aquatic insectivore discovered in West Africa by Du Chaillu, and named by him *Potamogale*, differs so much from all other members of the order that, like the solenodons, it forms the representative of a distinct family, *Potamogalidæ*. This otter-shrew (*Potamogale velox*) may be recognised by its otter-like form, and long, laterally compressed tail, passing almost imperceptibly into the body. In size it is large for an insectivore, the length of the head and body being 11 inches and that of the tail nearly the same. It has

a total of forty teeth, which have the same serial arrangement as in the long-tailed tenrecs, and are placed very near together. The head is characterised by the great width of the broad muzzle, which is provided with a number of large bristles, and has its nostrils closed by valves. The body is long and cylindrical, and the limbs are

short, with the toes not connected by webs. The body is covered with a coarse outer coat of long hairs and an inner one of a finer and softer nature, the colour of the upper hairs being dark brown, while the under parts are whitish. In certain lights, however, the dark portion of the coat is shot with a purplish metallic tint. The skeleton of the otter-shrew differs from that of all other Insectivora, except probably that of the geogale, in the absence of collarbones.



THE OTTER-SHREW

The compressed tail, becoming cylindrical at its base to join the body, and the presence of valves to close the nostrils, suffice to indicate the aquatic habits of this curious creature. In addition, there is the direct testimony of Du Chaillu, who observes that the otter-shrew "is found along the watercourses of limpid and clear streams, where fish are abundant. It hides under rocks along these streams, lying in wait for fish. It swims through the water with a rapidity which astonished me; before a fish has time to move round it is

caught. On account of the rapidity of its movements I have given it the specific name of *velox*. The animal returns to land with its prey almost as rapidly as it started from its place of concealment. The great motive-power of the animal in the water seems to be in its tail." For many years this remarkable animal was believed to be confined to the West African

rivers, but it is now known to occur in those of the Ituri forest, in East Central Africa, and therefore probably extends right across the equatorial forest-zone.

Probably more or less closely allied to the otter-shrew is a small mouse-like insectivore from Madagascar, described under the name of *Geogale*. This creature has thirty-four teeth, which resemble in form those of the potamogale, but our information is at present insufficient to render us certain as to its full affinities.

THE GOLDEN MOLES

THE golden moles, constituting the genus *Chrysochloris*, are so different from all other Insectivores of this group that they are referred to a distinct family, *Chrysochloridæ*. They are entirely confined to South and East Africa, where they are represented by several species, and are termed moles by the colonists. The skull of the golden moles differs from that of the tenrecs in possessing a distinct zygomatic arch below the socket for the eye, and also in that its tympanic bulla is bladder-like. In appearance these animals present some resemblance to moles, but have shorter and thicker bodies, with a deeper head and blunter snout. The whole form is admirably adapted to tunnelling through the ground; since the eyes are totally concealed beneath the hairy skin, and the minute ears are deeply buried in the fur. While the hind feet retain a normal form, the fore feet are specially modified for the purpose of digging, having only four toes, of which the two central ones are furnished with enormous triangular claws of great power. The more typical species have forty teeth, but in others, forming the subgenus *Amblysomus*, the number is reduced to thirty-eight, owing to the loss of the first pair of premolars in each jaw. The molar teeth have tall tritubercular crowns. The golden moles derive their name from the metallic lustre of the fur, which shows tints of green, violet, or golden bronze.

The runs of golden moles are made so near the surface of the ground that the earth is raised above the tunnel, which can be followed with ease in all directions. The food of golden moles consists mainly of earthworms.

The nearest relatives of golden moles appear to be the tenrecs, while ordinary moles are closely allied to shrewmice; and it is interesting to find two widely different groups of animals modified for a similar kind of subterranean life. This modification, however, has not followed the same lines in the two groups, for not only do the skeletons differ considerably from one another, but there is a more marked difference in the form and structure of the fore foot. Thus, while the fore foot of the true mole has assumed the well-known hand-like form, with an additional sickle-like bone near the thumb, that of the golden moles is of a totally different type, the power of digging being mainly due to the enormous horny claws of the two middle fingers.

R. LYDEKKER

STORIES OF THE INSECTIVORA

The common shrewmouse always enlists the interest and sympathy of the naturalist, for it is still the victim of a tradition which had its origin at a very early age. The male shrewmouse possesses, for defensive purposes, glands that emit an evil odour, as is known to the domestic cat, which, apparently for the sheer love of

killing, puts an end to the life of the creatures it cannot eat. This ill odour is probably responsible for the character for occult villainies which the animal bears. The Egyptians honoured it among their sacred animals, but less remote civilisation placed a ban upon it. The later estimate was that the shrewmouse was a malignant little monster, possessed of powers for mischief such as only the fertile imagination of the credulous could invent. Its bite was deadly poison, said the ancients, and English rustics still say so. Moreover, if a shrewmouse ran over the limb of man or beast paralysis of such limb followed. Horses or cattle stiff in the joints, or otherwise lame, were asserted to be "shrew-struck," or, in other words, had had a shrewmouse crawling upon the affected member. It was just as likely as not that mortification of the limb would ensue, and the afflicted man or animal be physically ruined (!) all because it had come in contact with one of the most inoffensive members of the mammalian family.

Old-time writers give us minute particulars of the reputed misdoings of the shrewmouse. "It is a ravening beast," declares Edward Topsell, "feigning itself gentle and tame, but, being touched, it biteth deep and poysoneth deadly. It beareth a cruel minde, desiring to hunt anything, neither is there any creature that it loveth." Topsell, who flourished in the seventeenth century, solemnly assured the world that its touch caused "cruel anguish," often ending in paralysis.

The learned author of the "Speculum Mundi" thus portrayed the shrewmouse: "It hath a long and sharp snout like a mole. In Latine it is called *Mus araneus*, because it containeth in it poison or venime, like a spider, and if at any time it bite either man or beast the truth of this will be apparent. But commonly it is called a shrewmouse, and from the venomous biting of this beast we have an English imprecation, 'Beshrew thee!' in which words

we do indeed wish some such evil. And again, because a curst scold or brawling wife is esteemed none of the least evils, we therefore call such a one a shrew." Shakespeare gave the latter term immortality.

Facing what they regarded as desperate situations, our fathers never hesitated to apply drastic remedies. Sir James Young Simpson, the introducer of chloroform as an anæsthetic, told how his father took part in the burial alive of a cow to appease the evil spirit which was fatally spreading the plague of murrain. And the same process of reasoning caused those who dreaded the shrewmouse to invoke the help of the "shrew-ash." The sovereign virtue of the shrew-ash was, and still is in some rural districts, that it prevented shrew-stroke, or, in the case of one already suffering, cured it. The cure involved more than a "hair of the dog," for a whole shrewmouse was utilised.

The high priest of the cure cut a hole in the trunk of

a sound ash, and in it enclosed a live shrewmouse, which was sealed up in the boring, and then left miserably to perish. A tree thus medicated, as Gilbert White well knew, would maintain its virtue for ever. Its twigs or branches, when gently applied to the limbs of cattle, would immediately relieve the pain which a beast suffered from the running of a shrewmouse over it. "Against this accident, to which they were continually liable, our provident forefathers always kept a shrew-ash at hand," so the Selborne naturalist recorded. There is—if, indeed, it still exists—one of these shrew-ashes, now sadly attenuated, but once a fine tree, near the Sheen Gate of Richmond Park, Surrey, and many still living can remember cattle and horses being taken to it for its healing virtues.

The English shrewmouse is not so purely insectivorous as some naturalists have thought. Buckland's observations led him to suspect that it is carnivorous, and he brought together some interesting facts. One of his friends made by chance a happy discovery. His butler, in the course of his duties, found a number of young frogs in a particularly damp cellar. To his surprise the man saw a young shrewmouse chasing one of the frogs. The butler caught up the fleeing frog, and so intent was the shrewmouse on its prey that it jumped after it, and was carried, holding on to the frog, up to the butler's master.

Another of Buckland's correspondents witnessed a desperate struggle between a water shrewmouse and a full-grown frog. Silently watching, the naturalist saw the former endeavouring to pull the frog out of a very small runnel of water, hanging on to the amphibian with bulldog tenacity. The frog was much alarmed, and repeatedly shook off its enemy by jumping. The shrewmouse was dazzled by the sun—for it was daylight—and could not see its prey a foot away, but infallibly tracked it each time by scent. The frog tried once or twice to bury itself in deep



THE COMMON SHREWMOUSE

Photograph by T. A. Metcalfe.

water, but its pursuer dived after it, seized it by the hind foot, and jerked till it had dislodged the fugitive from its hiding-hole. For fully a quarter of an hour this strange struggle lasted, and then the observer, having no more leisure, frightened off the shrewmouse with a touch of his glove, and taking up the frog, examined it. The teeth of the shrewmouse had apparently not broken the skin of the frog, which, however, showed signs of exhaustion.

"I think," wrote the witness, "that it would have taken an hour or two for the shrewmouse thoroughly to exhaust and kill so large a frog as this was, but the fatal result was easy to be foreseen." Frogs of smaller size would be easily overpowered." That being so, the gardener, while still admitting the shrewmouse to friendship as a destroyer of noxious insects, will look with disfavour upon it as the enemy of the frog, the ally of man against pestilential insects. E. A. B.

ORDER IV. CARNIVORA

GENERAL SKETCH OF THE FLESH-EATING MAMMALS

By R. LYDEKKER

UNDER the common title of Carnivora, or flesh-eaters, naturalists include all the members of that extensive assemblage of placental mammals comprising cats, civets, hyaenas, dogs, bears, weasels, etc., together with their aquatic allies the seals, walruses, and sea-lions. The name refers to their most distinctive habit, that of subsisting on the flesh of other animals; but it must by no means be assumed that all Carnivora are entirely, or even chiefly, flesh-eaters, the bears being notable exceptions. Neither must it be assumed, on the other hand, that the Carnivora are the sole flesh-eating mammals; since many of the lemurs and insectivores will eat the flesh of other vertebrates, while one group of marsupials is almost exclusively carnivorous. With the exception of the members of the last-named group, which are otherwise broadly distinguished, there is, however, no assemblage of mammals the members of which are so generally flesh-eating as the Carnivora, and the name is thus the most appropriate that could have been selected.

Had we to deal only with the existing forms of the animal kingdom, and if the seals and walruses were excluded—as is done by some naturalists—from the Carnivora, there would be no great difficulty in giving a short and concise definition which would at once distinguish the present order from all the others. The seals and walruses, however, differ so markedly in the characters of their teeth, as well as in many other structural points, from the more typical Carnivora, while a number of extinct forms show an approximation from the Carnivora to the Insectivora, that any such concise definition is impossible.

Among the characteristics common to all Carnivora, the following are some of the most important. In every case the toes are provided with claws, which are very generally sharp and curved, with no resemblance to nails; while the number of complete toes is never less than four to each foot and is frequently five. In no case is the first toe capable of being opposed to the other digits; so that a carnivore can in no sense be said to have a *hand*, in the popular acceptance of that term.

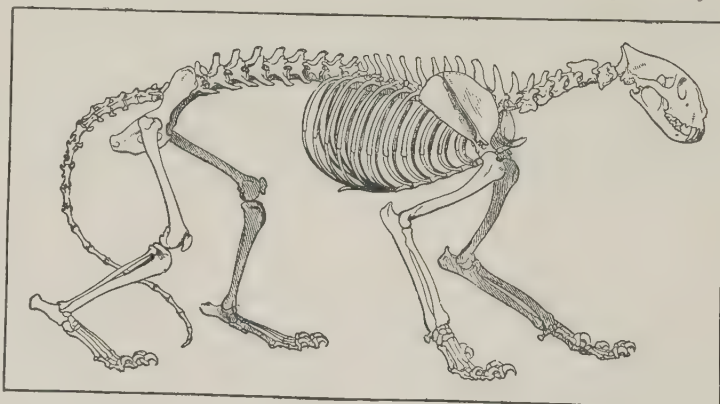
The teeth, in conformity with the flesh-eating habits of the great majority, are generally large and well developed; and are always divisible into incisors, tusks or canines, and cheek teeth. As a rule, the incisor teeth are three in number on each side of both the upper and lower jaws, and in no case do they exceed this number, and the third or outermost of these three incisors is always larger than either of the others, more especially in the upper jaw. Carnivorous marsupials, on the other hand, always have more than three pairs of upper incisor teeth. The tusks are large

and adapted for seizing and retaining the prey. The different families show a considerable diversity in the form and structure of the cheek teeth; but, generally, the more anterior of these teeth have sharp and more or less compressed crowns, while very frequently one pair of teeth in each jaw of the existing members of the order is specially modified to bite with a scissor-like action against an opposing pair in the opposite jaw. Moreover, in such Carnivora as have the crowns of the molar teeth flattened and expanded, these crowns are not divided into distinct portions by infoldings of the enamel, as is so frequently the case in those of rodents.

The most distinctive feature of the skull of the Carnivora is to be found in the mode of articulation of the lower jaw; the condyle, or projecting process by which the latter hinges on to the skull proper, taking the form of a half-cylinder, elongated in the transverse direction. This half-cylinder is received into a similarly-shaped hollow—the glenoid cavity—in the skull, bounded by overhanging edges. In consequence of this arrangement, the motion of the lower jaw of a carnivore is strictly limited to an up-and-down direction; thus allowing only of a biting or snapping action, and not permitting that rotatory or backwards-and-forwards movement found in so many other mammals. The interlocking of the lower jaw with the skull is most marked in the badgers.

A less important feature of the carnivorous skull is that in the great majority of instances the orbit, or cavity for the eye, is not bounded posteriorly by a bar of bone so as to form a complete ring, but communicates freely with the greatly elongated hollow on the side of the skull which contains the powerful muscles for working the jaws. Occasionally, however, as in some cats and the ichneumons, the eye socket is completely surrounded by a bony ring; and a process at the back of the upper part of the cavity for the eye always marks the posterior limit of that cavity. More constant is the presence of a strong zygomatic, or cheek arch, bounding the inferior border of the socket of the eye, and connecting the upper jaw with the region of the ear.

An important feature distinguishing the skeleton of a carnivore from that of an insectivore, with the exception of the



SKELETON OF THE TIGER

the otter-shrew, is that the collarbones, or clavicles, are frequently absent, and when present are never complete; that is to say, that instead of each collarbone forming a bar to connect the shoulderblade with the breastbone, as in man, when it exists at all, it merely forms a little splint of bone embedded in the muscles of the chest between these two points.

Two other features in regard to the skeleton must not be overlooked, since they are of some help in

THE FLESH-EATING MAMMALS

distinguishing between Carnivora and Insectivora. In many of the latter the two bones of the forearm (radius and ulna), and of the lower half of the leg (tibia and fibula), are respectively united, whereas in all the former they are completely separate. In the fore limb this separation of the two bones is essential in order to permit of the free use of the paw. A characteristic of the wrist joint of all Carnivora is that two of the bones of the upper row, respectively known as the scaphoid and the lunar, are completely welded together; and it may be added that the central bone, which exists in all the lower Primates, is invariably absent. Another feature distinguishing Carnivora from Insectivora is to be found in the well-marked convolutions on the upper surface of the lobes of the brain of the former, which are indicative of a far higher degree of mental power. Some of these characteristics will not apply to certain extinct members of the order.

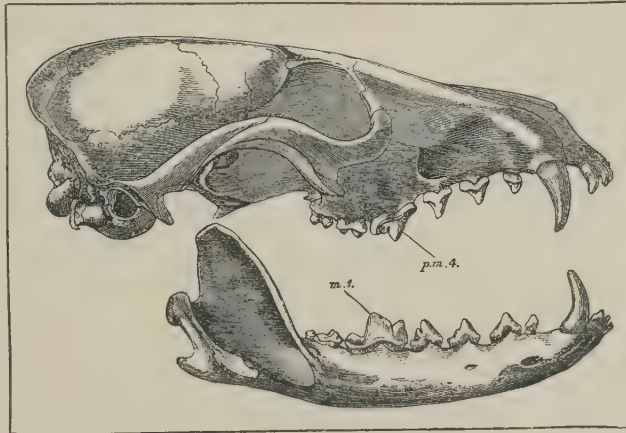
With the exception of Australia, New Guinea, and New Zealand, Carnivora are distributed over all the continents and larger islands of the globe, ranging from the icy ocean of the Arctic Circle to the tropical plains of Africa and India; but while some of the families, like the cats and dogs, have a distribution almost co-extensive with that of the order, others, like the civets and hyænas, are much more restricted in their range. Exclusive of the larger man-like apes, the Carnivora include the largest of the so-called ungulate mammals, that is, those in which the toes are furnished with claws or nails, in contradistinction to hoofs.

As is usually the case, the largest representatives of the order are to be found in the aquatic section, which comprises the walrus and the still more gigantic sea-elephant, or elephant-seal. Among the terrestrial Carnivora the largest species are to be found in the warmer parts of the globe, although the bears form, to a certain extent, an exception to this rule. The more typical and more purely carnivorous terrestrial members, which, as a general rule, subsist on the flesh of animals killed by themselves, are characterised by the elegance and neatness of their build, and by their bodily strength and activity, as well as by the fierceness of their disposition.

The terrestrial, or, as they are often called, in allusion to their free toes, the fissiped, Carnivora, otherwise the Carnassidentia, are, as a rule, adapted for a life on land, although some kinds, like the sea-otters and otters, pass a large portion of their time in the water. In no instance, however, are their fore limbs modified so as to assume the form of flippers, neither do their hind limbs ever present the peculiar structure characteristic of those of the seals, being, on the contrary, in most cases suited for walking with ease on the ground. Of more importance is the structure of the teeth of the modern land Carnivora.

In the first place, the presence of three pairs of incisor teeth in both the upper and the lower jaw is an extremely constant feature. Then, again, instead of the uniformity pervading the whole series of cheek teeth characteristic of the seals and their allies, the cheek teeth

of the terrestrial Carnivora of the present epoch are distinguished by having one of their number on each side of the upper and the lower jaws modified in a special manner so as to bite against one another in a more or less markedly scissor-like fashion. The tooth in the upper jaw thus specially modified is the last of those which have milk, or deciduous, predecessors, and is thus the fourth of the premolar series in those species where four of those teeth are developed. This is shown



SKULL OF THE FOX

The fourth upper flesh tooth is lettered *p.m. 4.*, and the fifth lower flesh tooth, *m. 1.*
From the "Proceedings" of the Zoological Society

in the accompanying figure of the skull of the fox, where the fourth upper tooth (*p.m. 4.*) behind the tusk is the one specially modified. In the lower jaw, however, in those groups which have the full number of teeth, it is the fifth tooth (*m. 1.*) behind the tusk which bites against the specially modified tooth in the upper jaw, as shown in the same figure. This modified lower cutting-tooth, which has no deciduous milk predecessor, is thus the first of the molar series. To these two pairs of modified teeth is applied the name of *flesh teeth*, as being those specially adapted

to cutting the flesh of the victims of the terrestrial Carnivora. The upper flesh tooth consists of an outer blade and of a strong tubercle on the inner side. The blade may consist of three lobes, or, as in the dogs and civets, of only two such lobes, which bite on the outer side of the lower flesh tooth in a manner well known to all who have examined the skull of a tiger, lion, dog, etc.

The lower flesh tooth likewise has a large cutting-blade on the outer side of its front portion, which is invariably divided into two distinct lobes, of which the second is usually the taller. In the more generalised Carnivora, such as dogs, the second lobe of the blade of this tooth has a small cusp on its inner side; while posteriorly the tooth is extended in the form of a long heel. The lower flesh tooth of the more specialised forms, such as the hyænas and cats, consists, however, only of the two-lobed blade, with or without a minute inner cusp and a small hind ledge representing the heel.

The order Carnivora dates from a comparatively early epoch in the geological history of the world, that is to say, from low down in the Eocene, or earliest division of the Tertiary, where they were represented by a number of genera, such as *Hyænodon* and *Sinopa* from Europe (including the British Isles), Asia, Africa, North America, and possibly South America. These primitive Carnivora, or Creodontia, differ from the more typical representatives of the modern group in the absence of a distinct pair of the aforesaid flesh teeth; all their cheek teeth being very much alike. That these creodonts should be included in the same order as the modern Carnivora is now generally admitted by naturalists.

It is possible that these early Tertiary creodonts may be not far removed from the earliest of all mammals, that is to say, may be the direct descendants of the mammal-like reptiles. Be this as it may, it is practically certain that the creodonts gave rise to the earliest known whale-like mammals, the extinct Zeuglodonts; and in this connection allusion may be made to a very remarkable circumstance. The bodies of these

whale-like zeuglodonts appear to have been protected by an armour of bony plates, somewhat similar to that worn by existing crocodiles and alligators. Whether this armour was inherited from the ancestral creodonts, or developed *de novo*, is uncertain, although it is well known that in the creodonts with which we are at present acquainted, such an armour, if it existed at all, must have been in a degenerate condition.

Possibly some light may eventually be thrown upon this difficult subject as the result of a discovery made by a German naturalist, Mr. Carl Toldt.

This observer has shown that foxes are descended from ancestors the bodies of which were clothed with horny scales like those of the pangolins, or scaly ant-eaters. Although these scaly ant-eaters are the only living mammals the bodies of which are completely covered with overlapping scales, armadillos furnish an example of another type of armour in the same class; while there are several groups of mammals in which some portion of the body is scaly. In rats, for example, the whole of the tail is scaly, and more or less distinctly scaled areas are met with in several porcupines and certain other rodents, as well as on the tail of the South American great ant-eater.

In all such scaly animals where hairs grow from the body between the scales, as they almost invariably do, such hairs, in place of being scattered in an irregular manner, have a distinct arrangement. They grow in isolated bundles, arranged in some cases in groups of three or four, and placed at regular intervals from one another, and from the fact that the hairs are also arranged in this peculiar and definite fashion in a number of species which show no traces of scales, it has been suggested that such mammals trace their descent from scale-clad ancestors.

Examination of the skins of young foxes has shown not only that the hairs are arranged in this peculiar fashion, namely, in groups of three, each bundle containing some fourteen or fifteen hairs, but likewise that the skin itself exhibits a structure such as would be presented by that of a pangolin after the scales had been pulled out. Viewed through a microscope, the skin presents, in fact, the appearance of a roof covered with overlapping rounded tiles, with the triply-arranged bundles of hair growing between each; and, when seen in cross-section, the skin is observed to be thrown into a series of ridges or steps, each of which represents the free edge of one of the tiles. To explain such a structure otherwise than as representing the bed of a scaly armour seems impossible, or, at all events, illogical, and there accordingly appears every justification for the view that the fox is descended from scale-clad ancestors. No actual traces of scales have been observed in any of the skins yet examined, but such

might possibly be detected if a large series of skins of young fox-cubs were examined under proper conditions.

Whether such a presumed scaly covering has or has not any connection with the bony armour of the zeuglodonts may be doubted; but that it was derived from the mammal-like reptiles seems beyond question. And, if so, the fox is precisely the animal that might be expected to inherit such a vestige, as the members of the dog family are some of the most generalised members of the entire carnivorous order.

With the exception of China, where "chow-chow" forms a favourite dish, the flesh of Carnivora, doubtless on account of the diet of these animals, is not much consumed as food by man. In many other respects, however, the Carnivora are of the highest value and importance to the human race. The dog, for instance, in the shape of its numerous breeds, is the only animal which can be said to be a true companion to man; and this in quite a number of ways.

Among the various uses to which dogs of different breeds are put, it must suffice to mention the driving and herding of sheep and cattle, the hunting in packs by scent of stags and other animals, the coursing in couples by sight of hares and rabbits, and the driving or drawing of burrowing animals from their holes, besides attending sportsmen in the field in pursuit of large or small game, guarding houses or other buildings, carrying burdens across the lofty plateaus and passes of Tibet, drawing small carts in Belgium and other parts of the Continent, and dragging sledges in the Polar regions.

The cat is a much less completely domesticated animal than the dog, and has, in fact, taken to a life under man's protection rather as a matter of convenience to itself than out of affection for man.

Ferrets are a domesticated breed of polecat employed for driving rabbits, rats, etc., out of their holes.

The splendid furs yielded by many species of northern

Carnivora, however, form the most valuable commercial product yielded by these animals; among such furs some of the most important being those of the sable, marten, otter, glutton, sea-otter, sea-bear, lynx, and black or silver fox, the fifth and eighth of these being the most valuable of all furs used for dress. To these must be added the pelts of various larger species, such as lions, tigers, leopards, bears, and wolves; the beautiful white fur of the Polar bear being of especial value.

Seals, other than sea-bears or fur-seals, as well as walrus, yield skins employed for leather as well as valuable oil, while the tusks of the walrus have likewise a considerable commercial value.

The Carnivora will be considered according to the following classification of the families, genera, and species, which will be mentioned in more or less detail.



THE SERVAL

An African member of the cat tribe

TABLE OF THE FLESH-EATING MAMMALS

DEALT WITH IN THIS WORK

SUBORDER 1

Typical Carnivora—Fissipedia, or Carnassidentia

FAMILY 1

The Cat Tribe—Felidae

GENUS 1
Cat—Felis
SPECIES

Lion	Felis leo
Tiger	F. tigris
Leopard	F. pardus
Snow leopard, or Ounce	F. uncia
Jaguar	F. onca
Puma	F. concolor
Clouded leopard	F. nebulosa
Marbled cat	F. marmorata
Sze-chuen cat	F. scripta
Fontanier's cat	F. tristis
Golden cat, or Bay cat	F. temminckii
Fishing cat	F. viverrina
Leopard cat	F. bengalensis
Serval	F. serval
Servaline cat	F. servalina
African tiger cat	F. celidogaster
Rusty-spotted cat	F. rubiginosa
Flat-headed cat	F. planiceps
Bornean bay cat	F. badia
South American tiger cat	F. tigrina
Costa Rica tiger cat	F. wiedi
Brazilian tiger cat	F. guttata
Colombian tiger cat	F. pardinoides
Chilian tiger cat	F. guigna
Argentine tiger cat	F. geoffroyi
Cordovan tiger cat	F. salinarum
Pampas cat	F. pajeros
Colocolo	F. colocolo
Jaguarondi	F. jaguarondi
Eyra	F. eyra
African wild cat	F. ocreata (maniculata)
European wild cat	F. catus
Manul cat, or Pallas's cat	F. manul
Desert cat	F. ornata
Waved cat	F. torquata
Domesticated cat	F. domestica
Siamese cat	F. siamensis
Jungle cat	F. chaus
Caracal	F. caracal
Lynx	F. lynx
Bay lynx	F. rufa
Mediterranean lynx	F. pardina

GENUS 2

Hunting Leopard—Cynælurus

SPECIES

Hunting leopard, or Chita	Cynælurus jubatus
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Extinct Cats

Great crested cat	Felis cristata
	F. atrox
	F. augusta
Sabre-toothed tiger	Machærodus
Archæælurus	Ælurictis
Nimravus	Æluroopsis
Dinictis	Pseudælurus
Hoplophoneus	

FAMILY 2

The Civet Tribe—Viverridae

GENUS 1

Foussa—Cryptoprocta

SPECIES

Foussa	Cryptoprocta ferox
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GENUS 2

Civets—Viverra

SPECIES

African civet	Viverra civetta
Indian civet	V. zibetha
Malabar civet	V. civettina
Malay civet	V. megaspila
Javan civet	V. tancungia
Rasse, or Lesser civet	V. malaccensis

GENUS 3

Genets—Genetta

SPECIES

Common genet	Genetta vulgaris
Victorian genet	G. victorie
Blotched genet	G. tigrina
Feline genet	G. felina
Senegal genet	G. senegalensis
West African genet	G. pardina

GENUS 4

Linsangs—Linsanga

SPECIES

Javan linsang	Linsanga gracilis
Burmese linsang	L. maculosa
Spotted linsang	L. pardicolor

GENUS 5

African Linsang—Poiana

SPECIES

African linsang	Poiana poënsis
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GENUS 6

Palm Civets—Paradoxurus

SPECIES

Celebes palm civet	Paradoxurus musschenbroeki
Woolly palm civet	P. laniger
Great-toothed palm civet	P. macrodus
Indian palm civet	P. niger
Malay palm civet	P. hermaphroditus
Golden palm civet	P. aureus
Brown palm civet	P. jerdoni
Himalayan palm civet	P. grayi
Chinese palm civet	P. larvatus

GENUS 7

Small-toothed Palm Civets—Arctogale

SPECIES

White-eared palm civet	Arctogale leucotis
Javanese small-toothed palm civet	A. trivirgata
Bornean small-toothed palm civet	A. stigmata

GENUS 8

Banded Palm Civets—Hemigale

SPECIES

Hardwicke's palm civet	Hemigale hardwickel
Hose's palm civet	H. hosei

GENUS 9

African Palm Civet—Nandinia

SPECIES

Two-spotted African palm civet	Nandinia binotata
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GENUS 10

Binturong—Arctictis

SPECIES

Binturong	Arctictis binturong
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GENUS 11

Water Civet—Cynogale

SPECIES

Water civet	Cynogale bennetti
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GENUS 12

True Mongooses—Herpestes

SPECIES

Egyptian mongoose, or Ichneumon	Herpestes ichneumon
Kaffir mongoose	H. caffer
Slender mongoose	H. gracilis
Red-tailed mongoose	H. sanguineus
White-tailed mongoose	H. albicauda
Indian mongoose	H. mungo
Small Indian mongoose	H. auro-punctatus
Ruddy mongoose	H. smithi
Stripe-necked mongoose	H. vitticollis
Crab-eating mongoose	H. urva
Javan mongoose	H. javanicus
Short-tailed mongoose	H. brachurus
Barred mongoose	H. semitorquatus

GENUS 13

Short-tailed Mongooses—Helogale

SPECIES

Small mongoose	Helogale parvula
Wavy mongoose	H. undulata

GENUS 14

Four-toed Mongoose—Cynictis

SPECIES

Thick-tailed mongoose	Cynictis penicillata
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GENUS 15

Four-toed Mongooses—Bdeogale

SPECIES

	Bdeogale crassicauda
	B. puisa

GENUS 16

Smooth-nosed Mongoose—Rhynchogale

SPECIES

Meller's mongoose	Rhynchogale melleri
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GENUS 17

Cusimanse and Banded Mongoose—Crossarchus

SPECIES

Cusimanse	Crossarchus obscurus
Gambian mongoose	C. gambianus
Zebra mongoose	C. zebra
Banded mongoose	C. fasciatus

GENUS 18

Meerkat—Suricata

SPECIES

Meerkat	Suricata tetradactyla
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GENUS 19

Malagasy Mongooses—Galidictis

SPECIES

Munguste	Galidictis striata
	G. vittata

GENUS 20

Malagasy Mongoose—Galidia

SPECIES

Galidia	Galidia elegans
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GENUS 21

Malagasy Mongooses—Hemigalia

SPECIES

Uniformly-coloured hemigalia	Hemigalia unicolor
Olive hemigalia	H. olivacea

GENUS 22

Malagasy Mongoose—Eupleres

SPECIES

Goudot's eupleres	Eupleres goudoti
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Fossil Civet-like Mammals

Ichtherium	Amelyctonus
Palæonictis	Ælurotherium

FAMILY 3

Aard-wolf—Proteleidæ

GENUS

Aard-wolf—Proteles

SPECIES

Aard-wolf	Proteles cristatus
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FAMILY 4

Hyænas—Hyænidæ

GENUS

Hyæna—Hyæna

SPECIES

Striped hyæna	Hyæna striata
Brown hyæna	H. brunnea
Spotted hyæna	H. crocuta

Extinct Hyænas

Colvin's hyæna	Hyæna colvini
Thick-jawed hyæna	H. robusta
Pikermi hyæna	H. eximia
Long-jawed hyæna	H. leptorhyncha

Palhyæna

FAMILY 5

The Dog Tribe—Canidæ

GENUS 1

Dog—Canis

SPECIES

Wolf	Canis lupus
Indian wolf	C. pallipes
Coyote	C. latrans
Antarctic wolf	C. antarcticus
Cuberou, or Abyssinian wolf	C. sinensis
Asiatic jackal	C. aureus
Egyptian jackal	C. lupaster
Morocco jackal	C. anthus
Variagated jackal	C. variegatus
Pigmy jackal	C. mensesi
Black-backed jackal	C. mesomelas
Side-striped jackal	C. adustus
Dingo	C. dingo
Domesticated dog	C. familiaris
Maned wolf	C. jubatus
Azara's dog	C. azare
Crab-eating dog	C. thous
Colpeo	C. magellanicus
Short-eared dog	C. microtis
Raccoon dog	C. procyonoides
Fox	C. vulpes
Grey fox	C. cinereo-argenteus
Kit fox	C. velox
Arctic fox	C. lagopus
Desert fox	C. leucopus
Corsac fox	C. corsac
Tibetan fox	C. ferrilatus
Indian fox	C. bengalensis
Hoary fox	C. canus
Cama fox	C. cama
Pale fox	C. pallidus
Ruppell's fox	C. famelicus
Fennec	C. zerda
Siberian dihole, or Wild dog	C. alpinus
Malay dhole, or Wild dog	C. sumatrensis

HARMSWORTH NATURAL HISTORY

GENUS 2
Hunting Dog—Lycan
SPECIES
 African hunting dog *Lycan pictus*

GENUS 3
Bush Dogs—Speothos, or Icticon
SPECIES
 Guiana bush dog *Speothos venaticus*
 Ecuador bush dog *S. riveti*

GENUS 4
Big-eared Fox—Otocyon
SPECIES
 Big eared fox *Otocyon megalotis*

Extinct Dogs
 Cynodictis | Proamphicyon
 Amphicyon | Protamphicyon
 Dinocyon | Temnocyon
 Daphenus

FAMILY 6
Bears—Ursidae
GENUS 1
Typical Bears—Ursus
SPECIES
 Polar bear *Ursus maritimus*
 Brown bear *U. arctus*
 Grizzly bear *U. horribilis*
 Tibetan blue bear *U. pruinosus*
 American black bear *U. americanus*
 Himalayan black bear *U. torquatus*
 Spectacled bear *U. ornatus*
 Malay bear, or Bruang *U. malayanus*
 Extinct cave bear *U. spelæus*

GENUS 2
Sloth Bear—Melursus
SPECIES
 Sloth bear, or Aswal *Melursus ursinus*

Extinct Bear-like Animals
 Arctotherium | Hemicyon
 Hyænarctus

FAMILY 7
Raccoon Tribe—Procyonidae
GENUS 1
Panda—Æluropus
SPECIES
 Great, or Short-tailed, panda *Æluropus melanoleucus*

GENUS 2
Ælurus
SPECIES
 Panda, or Red cat bear *Ælurus fulgens*

GENUS 3
Raccoons—Procyon
SPECIES
 Common raccoon *Procyon lotor*
 Crab-eating raccoon *P. cancrivorus*

GENUS 4
Cacomistles—Bassariscus
SPECIES
 Cacomistle *Bassariscus astutus*
 Sumichrast's cacomistle *B. sumichrasti*

GENUS 5
Bassaricyon
SPECIES
 Central American bassaricyon *Bassaricyon gabbi*
 Allen's bassaricyon *B. alleni*

GENUS 6
Coatis—Nasua
SPECIES
 Common, or White-nosed, coati .. *Nasua narica*
 Red coati *N. rufa*

GENUS 7
Kinkajou—Cercopithecus
SPECIES
 Kinkajou *Cercopithecus caudivolvulus*

FAMILY 8
Weasel Tribe—Mustelidae
GENUS 1
Tayras—Galictis
SPECIES
 Tayra *Galictis barbara*
 Grison *G. vittata*
 Allamand's Grison *G. allamandi*
 Andean grison *G. andina*

GENUS 2
Lyncodon

SPECIES
 Patagonian weasel *Lyncodon patagonicus*

GENUS 3
Marten Group—Mustela
SPECIES
 Pine marten *Mustela martes*
 Beech marten *M. folina*
 Sable *M. zibellina*
 American marten *M. americana*
 Fisher marten *M. pennanti*
 Indian marten *M. flavigula*
 Polecat *M. putorius*
 Siberian polecat *M. eversmanni*
 Tibetan polecat *M. larvata*
 Sarmatian polecat *M. sarmatica*
 American polecat *M. nigripes*
 European mink *M. lutreola*
 True mink *M. vison*
 Siberian mink *M. sibirica*
 Weasel *M. nivalis*
 Stoat, or Ermine *M. erminea*
 Long-tailed stoat *M. longicauda*
 Himalian, or Bridled, weasel *M. frenata*
 Himalayan weasel *M. hemachelana*
 Striped weasel *M. strigidosus*
 Yellow-bellied weasel *M. cathia*
 Pale weasel *M. alpina*

GENUS 4
Striped Weasel—Pœcilogale
SPECIES
 Striped weasel *Pœcilogale albinucha*

GENUS 5
Glutton—Gulo
SPECIES
 Glutton, or Wolverine *Gulo luscus*

GENUS 6
Ratels—Mellivora
SPECIES
 Indian ratel *Mellivora indica*
 African ratel *M. ratel*
 Black ratel *M. cottoni*

GENUS 7
Skunks—Mephitis
SPECIES
 Typical skunk *Mephitis mephitica*
 Long-tailed skunk *M. macrura*

GENUS 8
Small Skunk—Spilogale
SPECIES
 Lesser skunk *Spilogale putorius*

GENUS 9
South American Skunk—Conepatus
SPECIES
 White-backed skunk *Conepatus mapurito*

GENUS 10
Zorilles—Ictonyx
SPECIES
 Cape polecat *Ictonyx striata*
 Senegal zorille *I. senegalensis*
 Suakin zorille *I. erythraea*
 Libyan zorille *I. libyca*
 Bridled zorille *I. frenata*

GENUS 11
Ferret Badgers—Helictis
SPECIES
 Brown ferret badger *Helictis orientalis*
 Burmese ferret badger *H. personata*
 Musk ferret badger *H. moschata*
 Orange ferret badger *H. subaurantiaca*

GENUS 12
American Badger—Taxidea
SPECIES
 American badger *Taxidea americana*

GENUS 13
True Badgers—Meles
SPECIES
 European badger *Meles taxus*
 Persian badger *M. canescens*
 White-tailed badger *M. leucurus*
 Chinese badger *M. chinensis*
 Japanese badger *M. anacuma*

GENUS 14
Malay Badger—Mydaus
SPECIES
 Teledu *Mydaus meliceps*

GENUS 15
Sand Badgers—Arctonyx
SPECIES
 Indian sand badger *Arctonyx collaris*
 Small Indian sand badger *A. taxoides*

GENUS 16
Otters—Lutra
SPECIES
 European otter *Lutra vulgaris*
 North American otter *L. canadensis*

Brazilian otter *L. brasiliensis*
 Chilian otter *L. felina*
 Parana otter *L. paranensis*
 Smooth Indian otter *L. macrodus*
 Hairy-nosed otter *L. sumatrana*
 Barang *L. barang*
 Indian clawless otter *L. (Aonyx) cinerea*
 African clawless otter *L. (A.) capensis*
 African spot-necked otter *L. maculicollis*

GENUS 17
Sea Otter—Latax
SPECIES
 Sea otter *Latax lutris*

SUBORDER 2
Eared Seals, Walrus, and Seals—Pinnipedia

FAMILY 1
Sea Lions and Sea Bears—Otaridae
GENUS
Eared Seals—Otaria
SPECIES
 Southern sea lion *Otaria jubata*
 Northern sea lion *O. stelleri*
 Californian sea lion *O. gilliespii*
 Hooker's sea lion *O. hookeri*
 Australian sea lion *O. lobata*
 Northern sea bear *O. ursina*
 South American, or Falkland Islands, fur seal *O. australis*
 Cape fur seal *O. pusilla*
 New Zealand fur seal *O. forsteri*

FAMILY 2
Walruses—Odobœnidae
GENUS
Walrus—Odobœnus
SPECIES
 Walrus *Odobœnus rosmarus*

FAMILY 3
True, or Earless, Seals—Phocidae
GENUS 1
Grey Seal—Halichœrus
SPECIES
 Grey seal *Halichœrus grypus*

GENUS 2
Typical Seals—Phoca
SPECIES
 Common seal *Phoca vitulina*
 Ringed seal *P. hispida*
 Greenland seal *P. groenlandica*
 Baikal seal *P. sibirica*
 Caspian seal *P. caspica*
 Bearded seal *P. barbata*
 Banded seal *P. fasciata*

GENUS 3
Monk Seals—Monachus
SPECIES
 Monk seal *Monachus albiventer*
 West Indian seal *M. tropicalis*

GENUS 4
Leopard Seal—Ogmorhinus
SPECIES
 Sea leopard *Ogmorhinus leptonyx*

GENUS 5
Crab-eating Seal—Lobodon
SPECIES
 White, or Crab-eating, seal *Lobodon carcinophaga*

GENUS 6
Weddell's Seal—Leptonychotes
SPECIES
 Weddell's seal *Leptonychotes weddelli*

GENUS 7
Ross's Seal—Ommatophoca
SPECIES
 Ross's seal *Ommatophoca rossi*

GENUS 8
Crested Seal—Cystophora
SPECIES
 Crested, or Bladder, seal .. *Cystophora cristata*

GENUS 9
Sea Elephants—Macrorhinus
SPECIES
 Northern sea elephant .. *Macrorhinus leoninus*
 Southern sea elephant *M. falclandicus*

Primitive Carnivora
 Hyænodon | Sinopa
 Pterodon | Vulpasus
 Cynohænodon | Amphictis

THE CAT TRIBE

UNDER the general title of cats it is convenient to include all the living representatives of the extensive family of the *Felidae*, all of which, with the single exception of the hunting-leopard, may be classed in the genus *Felis*. The members of the family may be regarded as the ideal representatives of the Carnivora, being those most completely adapted in all parts of their structure to the pursuit and destruction of living prey. Their long, lithe bodies exhibit in its fullest perfection the combination of strength and agility distinctive of Carnivora in general; while their strength is so great that the larger species are enabled to kill and drag away animals of much greater bulk than their own.

The essential characteristics of all the living members of the cat tribe are to be found in the extreme shortness of their muzzles; in the reduction of the number of their teeth far below that in the more generalised Carnivora, such as dogs; in the powerful development of their tusks and flesh teeth; and in their strongly curved and retractile claws, as well as in the free and supple movements of their fore paws.

As a general rule, cats have thirty teeth, of which $\frac{1}{2}$ are incisors, $\frac{1}{4}$ canines, $\frac{1}{4}$ premolars, and $\frac{1}{4}$ molars. Occasionally, however, there may be only two premolars on each side of the upper jaw, thereby reducing the total number of teeth to twenty-eight. Thus a cat has at most only three or four cheek teeth on each side of the upper jaw, of which the last but one is the flesh tooth; while in the lower jaw there are only three of these teeth, of which the last is the flesh tooth. Both the upper and lower flesh teeth are of the same general type as those of the hyænas, and consist only of the two-lobed blade, without any trace of the inner cusp and hind heel which form such important elements in the corresponding teeth of the dogs and civets. The flesh teeth of the cats have, indeed, lost the whole of those elements which are adapted to masticating or bruising food, and are reduced simply to the condition of cutters. Moreover, the single molar remaining in the upper jaw is of such small size that it can be of but little, if any, use as a masticating agent; so that the dentition of the cats is adapted solely to seizing their prey, and devouring it by cutting off the flesh from the bones by the scissor-like action of the flesh teeth.

Any person who has watched a domesticated cat eating a piece of meat, or a captive lion or tiger shearing off huge morsels from its allotted meal, will understand the mode of action of these teeth. In all cats the tusks, or canines, are very long and strong,

and frequently have the hind border forming a sharp cutting edge, by which their rending power is much increased. An important feature distinguishing the lower incisor teeth of the cats from those of all other Carnivora is the fact that the whole series of six is placed in the same straight transverse line, whereas in other Carnivora the second pair of these teeth is thrust up above the level of those on either side.

The fore feet of all cats are provided with five toes each, whereas the hind feet have only four toes. The claws in which these toes terminate are invariably curved and sharp, and, with the single exception of the hunting-leopard, can be completely retracted within sheaths for their protection when not in use. The mechanism of the retraction of the claws is due to the peculiar shape of the terminal joints of the toes

and the mode in which they are articulated to the second joints. The terminal joint of each toe has the broad, sickle-like form of the horny claw which it supports, and it is articulated to the end of the second or preceding joint only by the lower portion of its vertically expanded base. From the end of the second joint there runs a ligament to be inserted on the upper side of the base of the terminal joint, the ordinary action of which is to draw back the whole claw upon the upper surface of the second joint, when it becomes nearly concealed within its projecting sheath. To the under side of the base of the terminal joint, however, there is inserted the end of a long tendon coming from one of the flexor, or bending, muscles of the fore leg. When the animal springs upon its prey, the paw, in the act of striking, is sharply bent upon the wrist by the action of these flexor muscles, the result of which is to pull

downwards the terminal joints of the toes, and thus fully expose the claws. In order to keep their claws in good condition most cats—from the tiger to the domesticated cat—are in the habit of drawing them down the bark of trees, whereby they are rendered sharp and clean.

All members of the cat tribe walk solely upon their toes, and are hence termed digitigrade; the hind part of the foot being entirely raised from the ground to form a continuation of the line of the leg. This mode of progression indicates a higher specialisation than the so-called plantigrade mode of walking, in which, as exemplified by the bears, the whole of the sole of the foot is applied to the ground. Formerly the distinction between digitigrade and plantigrade Carnivora was regarded as an important one in classification, but it is now known that nearly allied groups vary



THE HEAD OF A TIGER

greatly in this respect, and that the character is a purely adaptive one. The fore feet of cats are furnished with five toes. The innermost toe, however, corresponding to the human thumb, is placed at a much higher level than the other four toes, and is consequently of no use in walking. The missing toe in the hind foot corresponds to the human great toe. The stealthy walk characteristic of all the cats is due to the soft cushions, or pads, on the under surface of their feet; each toe having a separate small pad, behind which is a large one occupying the middle of the sole of the foot. The fore foot is thus furnished with six, and the hind foot with five foot-pads; but there is on the fore limb an additional pad on the outer side of the palmar aspect of the metacarpus.

The impression, or print, of a cat's foot always shows the form and number of the pads, and it should be particularly noticed that in such impressions there is no mark of the claws, which in walking are completely retracted. This affords a ready means of distinguishing between the footprints of a cat and a dog.

In order to enable them to lick off the meat from the bones, and perhaps also to aid in cleaning their beautiful fur, the tongues of all cats are furnished with a number of flat processes, or papillæ, which are inclined backwards, and assist the tongue to act as a most effective rasp. In this respect cats differ very markedly from dogs, in which the tongue is quite smooth; and it is probable that this difference may be accounted for by the fact that the teeth of dogs are adapted to cracking and breaking bones, which are then swallowed, while those of cats are not suited for this purpose, and the bones of their prey are consequently licked clean and left.

The fur of most members of the cat tribe is usually short and of even length over the entire body; but the male lion is an exception in this respect, owing to the development of the large masses of long hair on the neck and shoulders. Such species as dwell in cold climates, like the ounce and the lynx, however, have much longer fur; and it is noteworthy that when a species, like the tiger, inhabits both hot and cold regions the length of the fur varies according to the climate.

Very characteristic of all cats are the long bristle-like hairs, commonly known as "whiskers," but technically designated "vibrissæ," fringing the muzzle. These hairs are provided with special nerves, and act as delicate organs of perception to aid the animals in finding their way, and detecting objects during their nocturnal wanderings. In correlation with these nocturnal habits the eyes of the cats are large and full, and their pupils can be materially altered in size by the contraction or expansion of the iris, according to the amount of light they have to receive. In most cats the ears are short and rounded at the tips, but in the lynxes and some allied species they are elongated by the addition of tufts of long hairs to their tips.

The tail in the majority of the species is long, cylindrical, and capable of peculiar snake-like movements; these movements being brought into play when the animals are excited or in pursuit of their prey; but in some of the smaller typical cats and in all the lynxes

it is relatively short. In the lion it is furnished with a large brush of hairs at the tip. Very frequently the tail is marked with alternate dark and light rings.

The usual colouring of the members of the cat tribe takes the form of dark spots or stripes on a lighter ground; the ground-colour varying from shades of grey through tawny to yellowish or orange. The spots may be either simple, or in the form of rings or rosettes enclosing an area of darker tint than the general ground-colour of the fur.

From these ringed spots there is a gradual transition, as is well displayed in the marbled tiger-cat, to stripes, which are generally more or less vertical, and assume the most regular development in the tiger. In a few species, however, such as the lion and the puma, the entire colouring is tawny; but even then traces of spots may often be detected in certain lights, or spots may be distinctly developed in certain individuals or races, while the young are invariably spotted or otherwise marked. From this it may be inferred that the uniform tawny colouring of such species is an acquired character—probably originally adapted to the desert-haunting habits of



THE LYNX

the species in which it occurs—and that all cats were primitively either spotted or striped. A black colour among the wild members of the family is of comparatively rare occurrence, but is met with among leopards and certain other spotted species.

In point of size, the members of the cat tribe present a greater degree of variation than is found in any other family of Carnivora; the larger species, like the tiger and lion, being only equalled in bulk by some of the bears, while the smaller members of the family, like the rusty-spotted cat of India, are inferior in dimensions to the common domesticated cat.

The total number of living species of the genus *Felis* is probably about forty-five; these having a distribution in space nearly coextensive with that of the entire order of Carnivora. They do not, however, extend so far northwards as bears and foxes, and are totally unknown in Madagascar. The greater number of species—more especially those of large size—are found chiefly in the tropical and sub-tropical regions of the globe; but the evidence of their fossil remains proves that the geographical range of some of these species was much more extensive at an earlier period than is the case at the present time.

In diet, the cats are purely carnivorous, and although when pressed by hunger some are known to eat the flesh of any dead animals they may come across, as a rule they kill their own prey. This is always effected by cautious stalking, followed by a sudden final rush; and, although it is said that two or more lions will occasionally combine to drive game in a given direction, when it can be seized by another member of the party, the members of the cat tribe almost invariably pursue their prey alone. The general antipathy of the cat tribe to water is proverbial, but in the swampy Sundarbans of Lower Bengal the tiger has often been observed swimming from one marshy island to another; and the fishing-cat of India largely subsists on freshwater fish captured by itself.

THE LION

Till well on in the nineteenth century the title of "king of beasts" was almost universally bestowed upon the lion (*Felis leo*) by writers on natural history, on account of its majestic appearance and the assumed nobility and fierceness of its character. Of late years, however, there has been a tendency on the part of those who have had the best opportunities of observing the animal in its native haunts, to depose the lion from the proud position it so long occupied. The reasons for this change of view appear to be that when roaming abroad by daylight the lion does not carry his head so high as he ought to do in order to be entitled to the epithet majestic; while his disposition, instead of being noble and fearless, is considered by Livingstone and several other writers to be more correctly described as cowardly and mean. Although it is impossible to doubt the accuracy of such observations as to its true character, yet the magnificent proportions of the animal, coupled with the splendid mane decorating the head and chest of the males, render the lion by far the most striking in appearance of the whole of the cat tribe, and, indeed, of all the Carnivora. (See page 108.)

In common with other large Old World cats, the lion has the pupil of the eye circular; but it is distinguished from all the other members of the family by the long hair growing on the head, neck, and shoulders of the male to form the flowing mane. This mane varies considerably in size and colour in different individuals, but, contrary to what has often been stated, is present in Indian as well as in African lions, although maneless lions are occasionally met with in Africa. Frequently, but by no means invariably, the long hair of the mane is continued as a fringe down the middle line of the belly.

Another distinctive characteristic of the male lion is the brush of long hair at the tip of the tail. In the middle of this brush of hair, at the very extremity of the tail, is a small horny appendage—the so-called "thorn"—surrounded by a tuft, the use of which is still obscure.

The hair on the rest of the body of the male lion and on the whole of both the head and body in the female is short and close. In the adults of both sexes the colour of the body-hair is usually yellowish brown, or tawny, but the tint varies in intensity, and in the small Somali race tends to greyish. The long hair of the mane of the male may vary from tawny to blackish brown. Young male cubs are marked with transverse dark stripes running down the sides of the body, and likewise by a single stripe of similar tint along the middle of the back. In certain lights more or less faintly marked spots may be observed in many lions nearly or quite up to the period of maturity, these markings, as a rule, being more conspicuous in females than in males; and in the East African Masai race of the species spotting is distinctly developed in the adults of both sexes. The mane of the male does not make its appearance till the animal is about three years of age,

and continues to grow until the age of about six years. Although the full length of the period of its life does not appear known, it has been ascertained that a lion may live to thirty, and it is said even forty years.

As measurements of lions are frequently taken from skins, exaggerated notions of the length attained by large males have obtained currency. One lion, probably an Indian specimen, of which the dimensions were carefully taken, measured 8 feet 10 inches from the tip of the muzzle to the tip of the tail; 2 feet 11 inches of this being occupied by the tail alone. Mr. F. C. Selous, writing of South African lions, observes that "the following are the lengths of the pegged-out skins of six full-grown males shot by myself, and carefully measured with a tape-line: namely, 10 feet 3 inches, 10 feet 6 inches, 10 feet 9 inches, 10 feet 10 inches, 9 feet 7 inches, and 11 feet 1 inch. These are the lengths of the skins after being pegged out and stretched out to a certain extent. However, after having flayed it, I carefully measured the naked carcass of the largest lion. From the top of the front teeth to the end of the tail it measured 9 feet 7 inches, laying the tape along the curves of the body, and as all the gristle and meat of the nose had been cut away with the skin, and at least an inch must have been lost with the tuft at the end of the tail, I think it would have measured all but 10 feet before it was skinned, even without making any allowance for the mane." Females are generally about 1 foot shorter than males.

Little is known as to the height of a full-grown lion at the shoulder, but one measuring 8 feet 9½ inches in length had a height of 3 feet 6 inches, while a menagerie lion had a total length of 10 feet, of which the tail occupied 3 feet 2 inches. In regard to weight, Mr. Selous states that an African lion in poor condition shot in 1877 weighed 376 pounds; but a fine, well-nourished example killed later weighed 500 pounds. This weight, however, was exceeded by a male shot in the Orange River Colony in 1865, which is reported to have weighed over 583 pounds.

The skull of a lion may be distinguished from that of a tiger by the fact that in the former the so-called nasal bones, or those forming the roof of the cavity of the nose, have their superior termination on the forehead situated in the same transverse line as the terminations of the upper jawbones or maxillæ. In the skull of a tiger, on the other hand, the upper extremities of the nasal bones extend considerably higher up the forehead than do those of the upper



AN AFRICAN LION, WITH FULLY DEVELOPED MANE

jawbones. There is likewise a difference in the contour of the inferior border of the lower jaw of the two animals. The skull of a lion may also be distinguished from that of a tiger by the smaller size of the tubercle on the inner side of the upper flesh tooth. In the tiger this tubercle is little smaller than in the corresponding tooth of the hyæna, but in the lion it more nearly approaches the condition obtaining in certain extinct cats, although it extends nearer to the front edge of the

flesh tooth. The skull of an adult male lion may measure as much as 13 inches in extreme length, with a breadth of 9½ inches across the widest part of the cheek bones.

The range of the lion includes the whole continent of Africa, from Cape Colony to Abyssinia and Algeria, although in many of the more civilised districts the animal is now greatly reduced in numbers, or even completely exterminated. In Asia it is found throughout Mesopotamia and Southern Persia to the north-western districts of India, although it is now on the verge of extermination in the last-named country, where it survives, as the result of protection, only in that portion of Kathiawar known as the Gir Forest. It has never been known in the Malay region or, indeed, anywhere east of the Bay of Bengal.

According to the Old Testament, lions were formerly common in the Lebanon district, and even in the valley of the Jordan. In Palestine they survived till the time of the Crusades, in the twelfth century, and in Syria there is evidence of their existence from the earliest historical times to the present day. King Amenophis III., who reigned about 1400 B.C., is known to have hunted lions on a large scale in Northern Syria, where they must have been abundant. Testimony of this is afforded by the ancient historians and naturalists, such as Xenophon, Aristotle, Strabo, and Pliny, who refer to lion hunts in Syria and Arabia; the lions from the latter country being described as more powerful and more numerous than those of the Libyan desert.

Herodotus refers to the existence of lions in his time in Greece, and Dr. A. B. Meyer, who has investigated the evidence on this subject with great care, expresses himself convinced that in the time of the Father of History lions still survived in Greece and other parts of South-Western Europe, such as Rumania. He is further of opinion that the ancient Greek representations of lions, such as a lion hunt carved on the haft of a dagger from Mycenæ, were copied from nature at a time when lions still lived in the country in the wild state. Others are, however, of a different opinion. Mr. E. G. Lewis, in an article published in "Notes and Queries," for 1859, states that "the lions on the gate of Mycenæ are of great antiquity, but the occurrence of this animal in works of early art cannot be considered as evidence of its occurrence in the country. Sculptured lions occur more than once in connection with Etruscan tombs, and there is no reason to believe that lions ever existed in Italy."

As to this last objection, it is pointed out that these Etruscan lions are of much later date than those from Mycenæ, and were obviously copied from Asiatic examples. Dr. Meyer, therefore, concludes that the probability of the statements of the ancient historians being true is very great, although the matter cannot be settled till bones of lions are discovered in Greece.

Whether or no lions lived in Western Europe during the historic period, it is certain that at an earlier epoch the range of the species covered a large part of Europe, for bones and teeth discovered in the caverns, brick-earths, and gravels of the Continent and Great Britain, and originally described as belonging to a distinct species, under the name of *Felis spelæa*, afford incontestable proof that lions at one time were common over the greater part of Europe. How these prehistoric lions came to be exterminated there is no

means of ascertaining, but the destruction of those infesting Eastern Europe and parts of Western Asia during the historic epoch was probably effected—at least to a considerable extent—by human agency.

In South Africa lions are now scarce in the districts to the south of the Orange River, but are locally common in the regions farther north, such as Mashonaland. Although it is probable that its range may once have embraced the countries of Afghanistan and Baluchistan, the lion is now unknown in Asia to the north of India. Writing of the habitats of the lion in Western Asia, Canon Tristram states that lions occasionally cross the Euphrates, and that many years ago a lion's carcass was brought into Damascus. Between the Lower Tigris and Euphrates lions still abound. Sir Henry Layard saw them frequently, and during his excavations in the neighbourhood of Babylon found fresh traces of their footsteps almost daily among the ruins. They extend also far higher up, to the jungle on the Upper Tigris, above Mosul and Nineveh (the ancient Chebar), where Layard mentions an Arab being attacked by one, and escaping with the loss of his mare.

For a long period it was considered that the Indian lion differed from its African relative in the total absence of the mane in the male, and was, therefore, regarded as a distinct species. Moreover, owing to the differences in the length and colour of the manes of African lions from different districts, it was likewise held that there were two or more species in Africa. It

appears, however, that such variations do not indicate more than local races, and that there is only a single species. Although the Indian lion is not maneless, yet the mane is less developed than in the typical African lion, and the Indian lion is now recognised as a distinct race (*F. leo gujaratensis*), the Persian lion (*F. leo persica*) forming a second geographical race of the species.

In spite of the impossibility of specifically distinguishing between lions of different colouring, it is now recognised among naturalists that several local races of lions exist in Africa. It is, for example, ascertained that lions from the Cape and Algeria have larger and finer manes than those from other districts. Roualeyn Gordon Cumming states that the manes and coats in lions inhabiting open, treeless districts, like the great Kalahari desert of South Africa, were fuller and handsomer than in those inhabiting forest districts. It has indeed been considered that the manes of forest-dwelling lions are reduced in thickness by being torn by thorns and bushes, but this theory is considered untenable by Mr. Selous, who states that the lions of the open plateaus of Matabililand and Mashonaland, where scarcely a thorn-bush is to be seen, exhibit every degree of variation in regard to the length and colour of their manes, and that a similar variation holds good for the Tati country, which is thickly covered with thorn jungle.

At least six African races of lions are now recognised, among which the Somali race (*F. leo somaliensis*) is characterised by its small size and greyish tone of colour, and the Senegal race (*F. leo senegalensis*) by the slight development of the mane, while the Masai lion (*F. l. masaiica*), of German East Africa, is characterised by the presence of chocolate spots in the female, and, to a less degree, in the male, as well as by the slenderness and pointed form of the tail-tuft.



A LION CUB, SHOWING THE MARKINGS

THE CAT TRIBE: THE LION

In connection with this part of the subject, it may be mentioned that, as a rule, wild lions do not have such long and heavy manes or such good coats as the majority of those met with in European menageries. Moreover, while all the wild lions with good manes which came under the notice of Mr. Selous had a small tuft of hair on the elbow and another in the armpit, none was seen with the fringe of long hair along the middle of the under surface of the body, which is universally present in maned menagerie lions. "I do not say," observes Mr. Selous, "that cases do not occur of wild lions becoming equally hairy; but they must be very rare, otherwise I should have met with some among the large number of skins I have seen. The coat of the wild lion is very short and close, whilst that of lions kept in this country [England] becomes very much longer, and usually of a redder colour than the pale yellow or silvery grey hue of the wild animal. I could pick out the skin of a menagerie lion from amongst

this general inability to ascend trees has saved the lives of many sportsmen and travellers, although sometimes at the cost of a long and thirsty waiting.

Dr. Blanford, who had the opportunity of observing both lions and tigers in their native haunts, is of opinion that the former are bolder than the latter, while they are far more noisy. Very different impressions appear to be produced on different persons by the lion's roar, some listeners regarding it as a rather commonplace and by no means awe-inspiring sound, while others, and apparently the majority, speak of it in quite other terms.

Such conflict of impression must be largely due to personal disposition. Perhaps the lowest estimation is that of Livingstone, who writes that "it is calculated to inspire fear when heard in a pitchy dark night amidst the tremendous peals of an African thunderstorm and the vivid flashes of lightning which leave on the eye the impression of stone-blindness, while the rain pouring down extinguishes the fire, and there is neither the



LION AND LIONESS IN THEIR NATIVE HAUNTS

a hundred wild ones. Climate and regular feeding must, I think, have a good deal to do with the luxuriant growth of mane invariably to be observed in lions in confinement." As pictures and figures of lions used to be almost always taken from such specimens, an exaggerated idea of the size and beauty of the mane is current.

Like most of the larger cats, lions are essentially nocturnal in their habits, and are thus frequently only met with by chance in districts where, from the abundance of their tracks and from their nightly roarings, they are known to be plentiful. During the daytime they are accustomed to lie asleep in thick beds of reeds, where such are to be found, or, in drier districts, among thickets and bushes. From these and similar haunts, the lion issues forth at sundown to begin his nightly prowls; dark and stormy nights being those on which he is most active, while he is more cautious during bright moonlight, especially as regards his visits to the drinking-places. The lion is not a climber, and

protection of a tree nor a chance that your gun will go off. But when anyone is snug in a house or a waggon, the roar of the lion inspires no awe. A European cannot distinguish between the note of a lion and that of an ostrich. In general the voice of the former seems to come deeper from the chest; but to this day I can only pronounce with certainty from which of the two it proceeds by knowing that the ostrich roars by day and the lion by night. The natives assert that they can detect a difference at the beginning of the sound."

On the other hand, testimony as to the impressiveness of the lion's roar is borne by Roualeyn Gordon Cumming, who describes it as consisting at certain times of five or six repetitions of a low, deep moaning, ending off with a faint and scarcely audible sigh; while at others it takes the form of loud, deep-toned, solemn roars, quickly repeated, and increasing in intensity till the third or fourth, after which it gradually dies away in a succession of low, muffled growlings, like the roll of

distant thunder. The vibrating and reverberating sound of the roar is often intensified by the habit lions have of putting their mouths close to the ground while roaring, Livingstone mentioning an instance where a lion stood for hours roaring near his camp, and making the sound reverberate in this manner. The intensity and grandeur of the sound are largely increased when, as is not infrequently the case, a party of lions are heard roaring in concert; and the din reaches its height when two or three troops of lions approach a watering-place at the same time. On such occasions, writes Gordon Cumming, "every member of each troop sounds a bold roar of defiance at the opposite parties; and when one roars, all roar together, and each seems to vie with his comrades in the intensity and power of his voice."

As a rule, lions begin to roar with the falling shades of evening, and continue, with longer or shorter intervals, throughout the night; but in secluded and undisturbed districts the roaring is frequently sustained so late as 9 or 10 o'clock in the morning on bright and sunny days. During cloudy and rainy weather they will roar, although in a lower tone, throughout the day.

Although in some districts lions are commonly met either alone, or in pairs of males and females, this does not seem to be generally the case in the interior of South Africa, where it was formerly more usual to meet with four or five lions consorting together, while parties of from ten to twelve were not rare. Such a party of twelve may comprise about two adult males, three or four full-grown lionesses, and half a dozen large cubs, which, except for their somewhat slighter build, might easily be mistaken for immature females.

Mr. Selous mentions that he once came across a party consisting of a lion, three full-grown lionesses, and three small cubs; and he adds that if each of these females had possessed a pair of large cubs, such an assemblage would have been rightly termed a party of ten lions. Such a party, although comprising more adult males, was once encountered by Lord Randolph Churchill in Mashonaland. "We were riding along through a small open glade covered with high grass, Lee a few yards ahead of me, when I suddenly saw him turn round, cry out something to me, and point with his finger ahead. I looked, and saw lolloping along through and over the grass, about forty yards off, a yellow animal about as big as a small bullock. It flashed across me that it was a lion—the last thing in the world that I was thinking of. I was going to dismount and take aim, for I was not frightened at the idea of firing at a retreating lion; but Lee called out in succession five or six times, 'Look! look!' at the same time pointing with his finger in different directions in front. I saw, to my astonishment, and rather to my dismay, that the glade appeared to be alive with lions. There they were, trooping and trotting along ahead of us like a lot of enormous dogs—great yellow objects, offering such a sight as I had never dreamed of. Lee turned to me and said, 'What will you do?' I said, 'I suppose we must go after them,'

thinking all the time that I was making a very foolish answer. This I am the more convinced of now, for Lee told me afterwards that many old hunters in South Africa will turn away from such a troop of lions as we had before us. We trotted on after them a short distance to where the grass was more open, the lions trotting along ahead of us in the most composed and leisurely fashion, very different from the galloping off of a surprised and startled antelope." Seven lions were actually counted, while one member of the party believed there were several more in the troop.

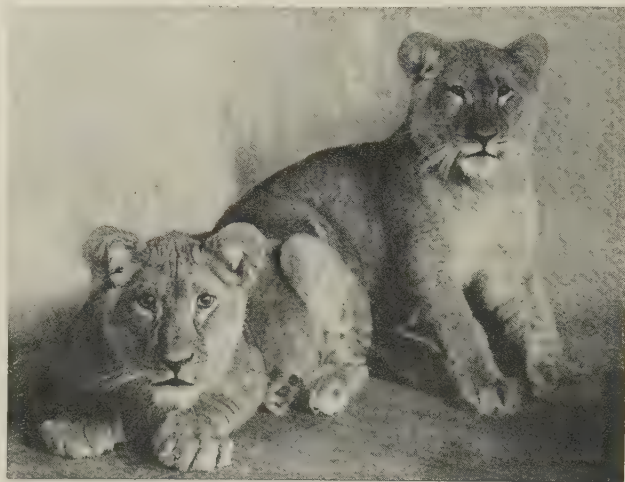
When a male lion has selected a female partner, the union generally lasts for life, or the greater portion thereof. From the evidence of specimens kept in captivity, it is known that from two to six cubs may be produced at a birth, at least in the captive condition. It is stated, however, that in India wild lionesses do not produce more than two or three cubs at a birth; and three appears to be the usual number in South Africa, where many cubs die while still young. Lions breed freely

in captivity, but not so readily in some menageries as in others. In the London Zoological Gardens, for instance, the number of cubs bred and reared is comparatively small; but in the Dublin Gardens a very large number are bred, many of the lions exhibited in various menageries having been reared at that establishment. Lion cubs are born with their eyes fully open. When caught young, lions are easily tamed, and the disposition of the animal in captivity is much more gentle than is that of the tiger.

That adult lions will combine to attack large animals which they would find it difficult or impossible to overcome unaided, is now well ascertained. One of the best-known instances was observed by Major Vardon and Mr. William Cotton Oswell in South Africa, when three full-grown males united their efforts in endeavouring to pull down an old buffalo. When first observed, the four animals were engaged in a terrific combat, the final issue of which might have been doubtful had it not been terminated by the sudden death of the buffalo from the effects of a bullet wound previously received from the rifle of one of the witnesses. No sooner, however, did their prey succumb than the three lions began to quarrel among themselves—one reared to half its height, resting its paws upon the middle of the carcase, while the other two respectively placed themselves at the head and tail, and growled forth defiance at the one in the centre. What might have been the result of the dispute can only be imagined, as two of the lions were shot; while the third, thinking discretion the better part of valour, prudently retired.

Although these lions, after securing their prey, fell out among themselves, such quarrels do not always occur in similar instances, since Gordon Cumming relates that he once saw as many as six lions feeding peaceably upon the carcase of a rhinoceros.

With regard to the ordinary food of lions, and the manner in which they attack the larger animals upon which they prey, in the oak forests of Persia their staple food is furnished by the wild pigs which frequent these



LION CUBS IN THE DUBLIN ZOOLOGICAL GARDENS

THE CAT TRIBE: THE LION

woods. In India, lions usually feed on deer, antelope, wild pigs, cattle, horses, donkeys, and camels, and formerly a large number of the latter were destroyed by them. In Africa, lions prey largely upon antelopes, zebras, quaggas, buffaloes, and giraffes, the Hon. W. H. Drummond stating that on the many occasions on which he had seen lions hunting by daylight he could not recall one when they were not in pursuit of buffaloes, while herds of those animals which he had been hunting during the day were scattered and dispersed by lions at night.

Lions do not restrict themselves to the flesh of animals that have fallen to their own attacks; and besides eating the flesh of animals recently killed, they will also prey upon carcasses in an advanced state of decomposition. Mr. Selous states that when elephants have been shot, "lions will prey upon the stinking carcasses as they lie festering in the rays of a tropical sun, and at last become a seething mass of maggots, returning night after night to the feast, until no more meat is left. This occurs in parts of the country abounding in game, where it would give a party of lions but little trouble or exertion to catch a zebra, buffalo, or antelope, and procure themselves a meal of fresh meat. In the same way, no matter how plentiful game may be, lions will almost invariably feast upon any dead animal left by the hunter, from a buffalo to a steinbuck, that they may happen to come across."

Near villages, when lions grow too old to be able to catch game for themselves, they will take to killing goats; while women or children who may happen to come in their way at night also become victims. On the other hand, when far away from human habitations, such decrepit lions are stated to catch mice and other small rodents, and will even eat grass at times, although this may be taken medicinally.

That such lions which have become too feeble to prey upon game would develop into "man-eaters" if they were permitted to live appears highly probable. Mr. Selous believes, however, that the absence of man-eating lions in those parts of Africa with which he is acquainted is due "to the superior boldness of the African natives over those of India, for even among the least martial tribes of South Africa, if two or three people are killed by a lion, the population of the surrounding country is roused, and, a party being formed, the lion is usually surrounded and stabbed to death with assegais; whilst, among such warlike tribes as the Matabili, if a lion only kills an ox, or even a goat, its fate is usually sealed, or, even if not killed, it gets such a scare that it is glad to quit the district. Such a thing as a man-eater, or even a habitual cattle-slayer, would never be tolerated for an instant."

With regard to the methods in which lions kill and carry off the larger animals upon which they prey, it may be observed that there is some doubt whether death is effected by dislocating the neck of the victim,

as is always done by tigers. Dr. Blanford states that in a cow killed by a lion in Abyssinia the vertebrae of the neck were not dislocated; and that he also saw a lioness hold a camel for several minutes without attempting to break its neck. Mr. Selous is of opinion that lions have not one uniform way of killing their prey, but vary this according to circumstances. Thus he relates how he has seen a horse, a young elephant, and two antelopes slain by a bite in the throat; while he has also known instances of horses and zebras being killed by a bite on the back of the neck behind the head. Buffaloes, he believes, are sometimes slain by a dislocation of the neck, which is effected by the lion springing on to the shoulder, then seizing the nose with one paw, and giving the neck a sudden wrench.

It was formerly a prevalent notion that lions were in the habit of carrying off the carcasses of large animals, like oxen and buffaloes, by throwing them over their back and walking away with them. Modern observers, however, are agreed that this is not a correct statement, and that their invariable practice is to transport such carcasses by dragging them along the ground. In this manner lions carry off not only the bodies of the larger animals, like buffaloes, but also those of the smaller antelopes; and in the opinion of Mr. Selous no South African lion would be capable of lifting a buffalo from the ground, much less of leaping over a fence with it, as the lion of North Africa has been alleged to do.

The usual pace of a lion when undisturbed is a walk, but even then, from the length of his stride, he gets over the ground quicker than appears to be the case. When going more rapidly, lions do not bound, but progress at a clumsy gallop, somewhat after the manner of dogs, getting over the ground very quickly.

In regard to the ferocity or otherwise of the lion's disposition, conflicting statements will be found in the writings of different observers. Livingstone, for instance, states that nothing would lead him to attribute to the lion either the ferocious or noble character

ascribed to it by others, while Sir Samuel Baker was disposed to take the opposite view, observing that, although he did not consider the lion to be either so formidable or so ferocious as the tiger, yet there is no reason for despising an animal which has been respected from remote antiquity.

All observers appear to be agreed that, as a rule, a lion will not go out of his way to make an unprovoked attack upon human beings, and that, in point of fact, he will rather shun a conflict when possible. "There is nearly always," writes Mr. Drummond, "some explanation of its behaviour when it acts otherwise: either the

hunter has approached so near before being discovered that the animal is afraid to turn tail, and, urged by its very fears, makes a charge; or it may be half-famished, and having got hold of some prey, either of your killing or its own, will not quit it



A MANELESS LION FROM SENEGAL

without a contest; or, if a lioness with cubs, will fight in defence of her supposed danger."

That lions, especially when hungry, will on occasion attack human beings—on foot or when mounted—there is abundant evidence. Livingstone relates an instance of a hunter who, while engaged in stalking a rhinoceros, was, on looking back, horrified to find that he was himself being stalked by a lion. Mr. Drummond also records a case where a lion, driven by hunger, attacked him personally, and believes that there are some lions which will always make unprovoked attacks, this opinion being supported by an account of an attack made upon three natives in Eastern Africa.

The three men were passing along the edge of a certain lagoon, "when, without further warning than a slight rustle, a lion sprang upon the foremost, crushing him to the ground. His terrified comrades, throwing away the chance of shooting the brute while it was still upon its first victim and its eyes probably closed, rushed to the nearest tree for safety, but, once there, feeling ashamed of their cowardly desertion of an

mastery, and with one crunch of its powerful jaws put him out of his pain." The sole survivor of this tragedy, after having been besieged for hours in the tree, during which he had a hairbreadth escape when descending to reach his gun, had the satisfaction of putting a bullet through the ribs of the lion.

Concerning the dangers of lion-hunting in Africa, which is usually conducted on foot, Mr. Selous, writing in 1881, when sixteen lions had fallen to his rifle, considers the lion a far more dangerous animal to encounter than any other creature in South Africa. It is true that a much greater number of casualties occur from buffalo-shooting than in lion-hunting, but then, for every lion formerly "bagged" in the interior of South Africa, at least fifty buffaloes were laid low.

As a rule, the danger is reduced to a minimum when hunting with dogs, as the lion's attention is generally concentrated on his canine foes; but even then it sometimes happens that he will dash straight through them to attack the hunter. A mounted hunter, except when the movements of his horse are impeded by thick forest or by yielding sand, can usually escape when pursued, as the pace of the average lion will not enable him to overtake the average horse. "If, however, on foot," writes Mr. Selous, "and without dogs, though there is little danger in attacking lions in the first instance, yet to follow up a wounded one is very ticklish work, especially in long grass or thick cover, for there is probably no animal of its size in the world

that can conceal itself behind so slight a screen, or rush upon its pursuer with such lightning-like rapidity." It was also Mr. Drummond's opinion that if a hunter came to close quarters with a lion, death would be the probable end—to the man.

Writing of his experiences in Somaliland, Mr. J. D. Inverarity observed that the lion tries to avoid man till wounded, and it is only when there are young ones to guard, or when astonished at seeing the hunter so near to them, that they attack when being



A LION

old companion, they descended, and, walking forward together, were just on the point of firing, when, with a roar that almost deprived them of the power to run, the lion charged, caught the hindmost, and after shaking him for a second or two, gave chase to the other, who, however, had profited by the time to remove himself, by a bare foot or so, out of reach of the spring the enraged animal gave as it saw that one had so far escaped. It then returned to its last victim, not yet dead, took him up in its mouth, dropped him, tossed him from paw to paw as a cat does a mouse, and at last, as if wearied by so much unaccustomed gentleness, it allowed its savage nature to gain the

tracked. They charge with a coughing roar and at great speed, close to the ground. "Solarge an animal coming at full speed against you of course knocks you off your legs. The claws and teeth entering the flesh do not hurt so much as you would think. The only really painful part of the business is the squeeze given by the jaws on the bone. I experienced none of the dreamy stupor Livingstone describes, but, on the contrary, felt as usual. I adopted the course of lying quite still, which, I believe, is the best thing one can do, as you are quite helpless with a heavy animal on you, and they are inclined to make grabs at everything that moves, and the fewer bites you can get off with the better."

R. LYDEKKER

THE INDIAN LION

Natives call the Indian lion *oontia bagh*, which means "camel-like tiger." I have never met an Indian lion in its wild state, but I have observed several specimens in captivity. The Indian lion has virtually ceased to exist, except in the Gir, in Kathiawar. A friend of mine shot what was supposed to be the last lion in the Abu jungles, and I believe that the last lion in Central India was shot in the Gwalior jungles, I think about 1885. In 1888 it was reported to me that one had been seen in the Neemuch jungles, but I doubted the report. The lions in the Gir are partially preserved, and can only be pursued with the permission of the native chief.

In comparing the Indian lion with the African, I think that the average African is the larger. I have before me the following measurements of the skulls of two African lions, the data having been supplied to me by Mr. Spicer, the taxidermist of Leamington: No. 1. Basal length of skull from back to front, $16\frac{1}{2}$ inches; width across zygomatic arches, 10 inches. No. 2. Basal length of skull from back to front, 16 inches; width across zygomatic arches, $10\frac{1}{2}$ inches. I venture to say that such skulls were never possessed by any Indian lion, the skull of which rarely exceeds 14 inches.

Lions never existed in the Indian jungles in such numbers as tigers do, and I have my own ideas respecting the disappearance of the former. I think it will be allowed that wherever lions and tigers have roamed the same jungles, the lion has gradually vanished. For one thing, it is very likely that the lion, being the rarer animal, has been more sought for by sportsmen, and for another, that tigers have driven away or killed the lions. As a parallel, one knows that the presence of French partridges in the east of England is detrimental to English partridges, and other birds and animals oust weaker neighbours of their kind from a district.

Tigers are fonder of water and swamps than is the Indian lion, which loves thorny dry jungles. This preference on the part of the tiger gives it certain refuges in India where no Europeans can live during the rainy season. Accordingly, in certain districts, tigers enjoy peace for a considerable portion of the year. Lions, which in the past have invariably lived in dry, non-pestilential districts, have thus been exposed to sportsmen's attacks all the year round.

I can quite understand hunters writing that the lion's roar is louder than the so-called roar of the tiger, but while the lion roars—I have heard them by night at New Brighton and in Bombay, where a great circus was temporarily erected,—the tiger's demonstrations of rage and hunger appear to sound more like repeated hoarse coughs. I have heard a tiger keep up this noise in winter for a full hour.

As to the question of the thorn in the lion's tail, in Mr. Spicer's cellars I have examined lions' skins from Africa, and there were no thorns on them; but the Indian variety, I believe, has what is called a thorn. What is it? It is really the last joint of the tail which the circulation of the blood does not reach, and is more

pronounced in old lions and is sometimes bent. The tuft of hair grows round the second and third joint. The hard joint is one of the kindest devices of nature to protect the end of the tail and prevent it from becoming sore. The ends of all animals' tails are extremely sensitive, and I have often seen monkeys, both in their wild state and in captivity, exhibiting the greatest concern over their latter ends. If you watch certain monkeys in the "Zoo," you will often see their tail-ends bleeding. A monkey will pick up his tail, look at it, give it a scratch, and then drop it with a look on his face as much as to say, "I can't do anything for you." Roaming as the lion does through thorns and over red hot rocks, it is saved by nature from the monkeys' common trouble.

Of course, the notion that the thorn was ordained to make the lion lash itself into a state of extra special fury is ridiculous. In reference to the claws of the lion—whether Indian or African,—

there is no doubt but that they are not nearly so strong or so large as are those of the tiger.

Lions in captivity have generally finer manes than those shot by hunters, and Indian lions in confinement are mostly very ferocious. I was once travelling to Kutch Bhuj, and alighted at Morvi station. The chief of Morvi had promised to send a vehicle for me, and whilst waiting for it, I wandered about the place, and arrived at a mud house with barred windows. I thought that it might possibly be a police chowkee, and looked through the bars. My inquisitiveness was rewarded by the charge of a full-grown male lion at the bars; fortunately I was not touched. The beast had been lying low on the floor of the outhouse, waiting until he thought he could, with a single spring, reach me. I was afterwards told that, although the lion took little notice of natives, he evinced the greatest rage if a European approached.

F. G. ALEXANDER.



LIONESS AND CUBS SHARING A MEAL

Photograph by Topical

STORIES OF THE LION

Latterday experiences in Africa go to prove that though the number of lions is rapidly decreasing, so that in time the king of beasts will be as great a rarity in the Dark Continent as it has become in India, yet, in spite of the warfare incessantly carried on against him, this animal, instead of fearing man more, fears him less than of yore. It is common knowledge, of course, that when the hunter is up, the lion prefers to be abed. Hence, taken at a disadvantage when hunted out of his lair in the daylight, the lion, at his best and boldest by night, more often than not prefers to avoid conflict with man when the sun is up in the heavens. But, once roused, he is as terrible a foe as ever, while at night he is even more daring than formerly, familiarity with the presence of man in his domain having apparently made him regard with contempt all endeavours to keep him at bay. Events in Uganda have shown that the lion need not be old or decrepit to become a man-eater; the chance to catch and kill man provides him with sufficient excuse.

Mr. Roosevelt's hunting of the lion in 1909 enabled him fully to realise that his quarry is, in spite of the

hunter's perfect equipment, a much-to-be-feared foe. Discussing the views of men of greater experience than himself, he agrees with those who say that the lion is of all animals the most dangerous of opponents. He notes that hundreds of white hunters and thousands of native hunters have been killed or maimed during the past few decades in Africa, and that, while buffaloes, elephants, and rhinoceroses have contributed to the tragic total, lions are chiefly responsible. Of the fifty white men killed or mauled in British and German East Africa within the three or four years preceding his visit, the great majority had fallen to lions. In Nairobi he saw the graves of eight men who had fallen in battle with the beasts: seven had been killed by lions, the eighth by a rhinoceros.

The whole atmosphere of the place was such as to impress him with the ferocity and prowess of these brutes. The first man he met there had, in the previous year, been terribly mauled by a lion. Next came a man who, from hunting a lioness, had in turn been hunted by her, thrown down, and so badly bitten that he was crippled for life. Hard by he met the survivor of an adventure in which two settlers, Messrs. Lucas and Goldfinch, had been, one killed, the other permanently maimed by a lion. The beast had charged them as they rode on horseback. Goldfinch was bowled off his horse and shockingly bitten. Lucas, on going to his friend's assistance, was in his turn knocked out of his saddle by the lion, which then lay down and bit him to death before Goldfinch, wounded as he was, crawled over and shot the great beast as it held fast by his friend.

The ex-President's experience confirms the theory that the lion has no one set form of attack. Captain Slatter was able to tell him of a thrilling adventure which compelled him to watch a lion's attack upon a fleeing man. Wounded by an insufficient charge, the lion attacked Captain Slatter and knocked him down, but, seeing a native gun-bearer fleeing, it set off after him, and Captain Slatter saw it, on overtaking the native, rise on its hind legs and strike him down. Men are not its natural prey. Mr. Roosevelt found many animals which lions had killed—quite a hundred in all. They were chiefly zebras and hartebeests. From an examination of the remains, it was possible clearly to reconstruct the tragedy.

In the case of one zebra the lion had sprung bodily upon it, bearing it down by his weight, while he bit it through the neck. The legs of the zebra were spread out under it as it had sunk down, upon its belly, not upon its side, and the splintered vertebrae of the neck showed with what force the lion had bitten to kill. In the case of a hartebeest there was evidence that the lion had allowed his hind legs to remain on the ground, while with his fore paws he had seized the victim by the head and broken its neck.

Though he found that lions would charge at him in the daytime, Mr. Roosevelt met with no nocturnal adventures with the great cats. He was in a district, however, where such experiences not long before had

been common. He camped one night upon the site of a particularly terrible adventure. One of the officials in charge of an expedition, which was going up to Uganda, slept at night in a tent with the flap open. There was a native sentry on duty near the tent, yet during the night a lion crept up, made its way into the tent, seized the sleeping man and dragged him forth. His struggles and outcries brought assistance, and in the rush of men, the lion dropped his prey and bounded off. The sufferer's wounds were dressed, and he was put back to bed, in the same tent. The camp grew quiet again, but in an hour or two the lion returned to his victim. He re-entered the tent, seized the wounded man in his jaws, and, this time undeterred, bounded away with him into the darkness and devoured him.

A cornered rat will fly at a man as readily as a lion, but the lion is "cornered" if he be wounded. A bullet which is not fatal, will make a fleeing lion turn pursuer. A tiger will attack an unarmed man in the daylight; the lion, unless pressed by hunger, is frequently content to let well alone in similar circumstances. In 1903 two remarkable instances of the ease

with which the onslaught of a lion may be averted in the daytime were reported in "The Field." In one case a correspondent who had just emptied his rifle, found himself unexpectedly confronted by a troop of lions. The only weapon handy was his field-glasses. These he discharged at the lions with an accompanying volley of yells. The lions took to flight.

Mr. Percy C. Reid, of Kelvedon, wrote an account of an experience of the same character. While shooting in Barotseland, he caught sight of the head and forehead of some animal lying in the tall grass and, thinking it to be a doe reed buck, took a careless shot, and missed, with the only weapon he had—a gun of extremely light calibre. To his astonishment the supposed reed buck bounded up, and proved to

be a full-grown lion, close beside which were three lionesses. Man and animals watched each other intently for a moment, then the lions slowly moved away. When about 100 yards distant they halted, and faced round again. Then one of the lionesses charged full gallop back at him. The hunter dared not risk a long shot, so he waited until she should come within ten or fifteen yards of him, meantime standing perfectly still.

His immobility puzzled, perhaps alarmed her. At any rate, after she had run sixty or seventy yards, she changed her mind, for she now slewed off to one side, and went past at a gallop, looking back at him over her shoulder, and growling savagely until she disappeared in a patch of tall grass.

Mr. Reid not unnaturally came to the conclusion that had he fired it would have been the signal for his destruction, and Mr. F. C. Selous, to whom the case was put, held that, had he struck home and killed one of the lionesses, the other three would probably have bolted, but had he only injured one, then that one, with the other three, would have made common cause against him and charged at the same time.



A LION IN THE ZOOLOGICAL GARDENS, LONDON



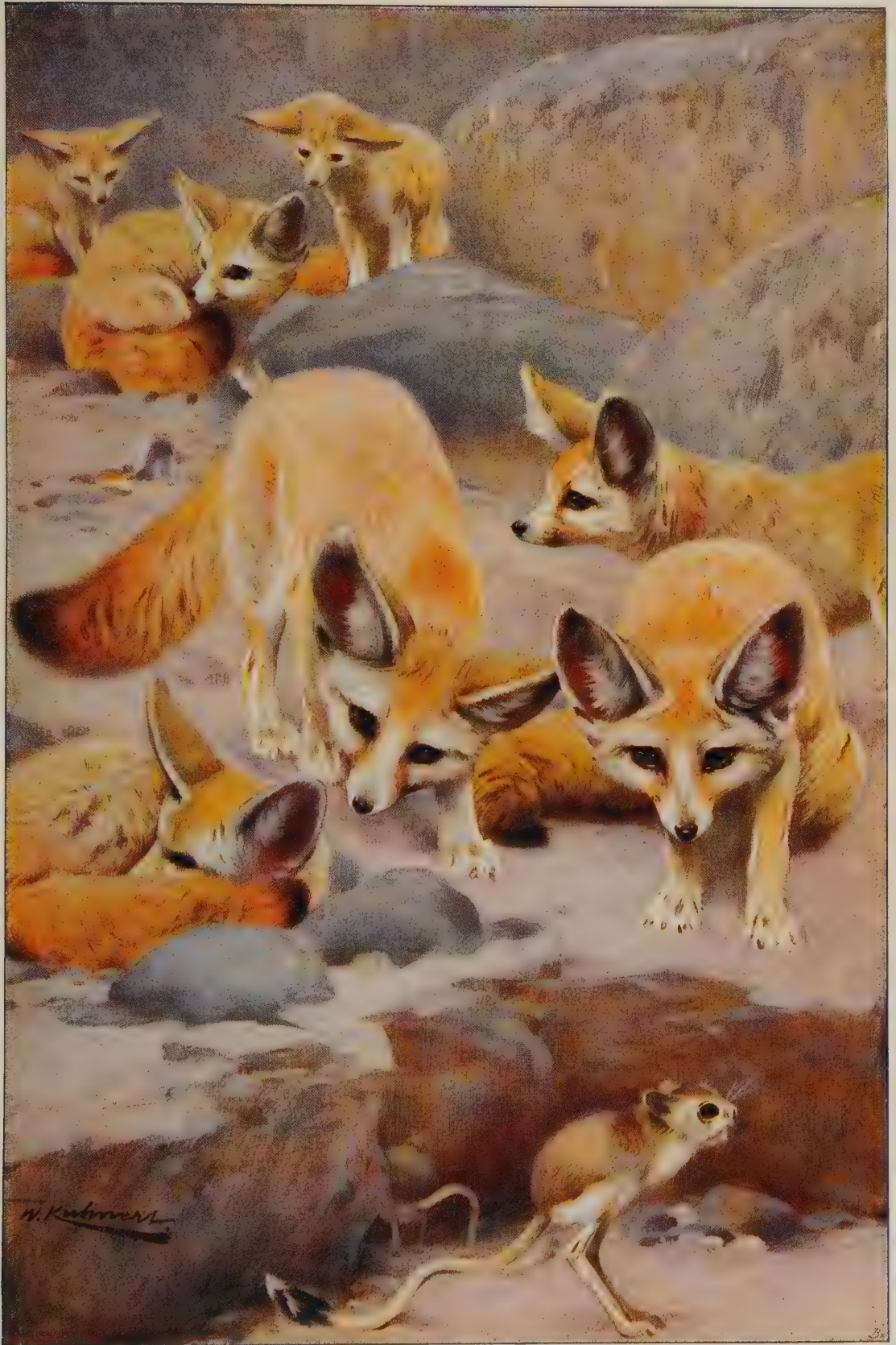
WOLVES

"Wolves inhabit both open country and forests, and, although generally found in pairs or solitary, at times, and more especially in winter, they associate in large numbers."



FOX

"The prey of the fox consists," writes Professor Bell, "of hares, rabbits, and various kinds of ground birds, particularly partridges, of which it destroys great numbers."



FENNECS AND JERBOA

"The fennec is confined to Northern Africa, ranging from Nubia to Algiers, and occurring over the whole of the Sahara Desert. . . . After having satisfied its thirst, the fennec sets about seeking its food, which may be jerboas, small birds, lizards, insects, or fruit."



BROWN BEAR AND CUBS

"The brown bear is a comparatively unsociable animal, though not infrequently a male and a female may be seen together, while the females are, of course, accompanied by their cubs."

STORIES OF THE LION

There is, of course, always the temperament of the individual lion to be considered in laying down a proposition of this character. One of Roualeyn Gordon Cumming's adventures failed to bear out the theory which Mr. Selous and Mr. Reid express. Coming suddenly upon two full-grown lionesses, he fired at the nearest, the only bullet shot he had in his rifle. The animal struck wheeled round, and, lashing her tail and growling fiercely, came at him at once, while her companion beat a retreat. Cumming, defenceless, stood up, holding his rifle in both hands above his head. The lioness halted for a moment, but resumed her charge. It was a moment of grave peril for the hunter, but he kept his nerve, and yelled, "Halloa, old girl, what's the hurry? Take it easy there: Halloa, halloa!" She again halted, perplexed, as if unable to grasp the situation, and he was able to retreat, shouting at her all the time.

So much for the lion by day. The lion by night is quite a different animal, and lucky is the man who escapes the clutches of one when the sun goes down. With all its faculties alert, the lion, pressed by hunger, becomes the embodiment of ferocity and stealth. It is skilful enough to avoid traps, and not infrequently the man who essays its capture, himself falls the victim. Such was the end of an attempt to catch a man-eating lion at Kiu, when the Uganda railway was building. The lion having carried off several coolies, three men—Mr. Ryall, an Englishman, Herr Huebner, German consul, and an Italian, Signor Parenti—lay in wait for the brute.

They established themselves for the night in a railway carriage, which was a saloon, with a compartment for native servants adjoining. Later it was decided that the German and Italian should take a rest, while Ryall kept watch by himself. The German retired to a sleeping-berth, while the Italian lay down on the floor. So far all had been quiet, with no sign of the lion. Mr. Ryall had, indeed, remarked to his friends that the fireflies near the carriage seemed exceptionally large and bright, and had mentioned, too, that he had seen a rat cross and re-cross a spot where the rail glinted in the moonlight. Those "fireflies" were, in reality, the eyes of the lion; the "rat" was its tail, dragging across the metals!

All was silent, and the German and the Italian slept. Ryall also must have dozed, sitting in a chair facing one open window, with his back to the corresponding open window on the other side of the carriage. Suddenly there was a terrible commotion in the saloon. The lion which the three had set out to catch was in their midst! It had leapt through either a doorway or the open window of the railway carriage, and had pinned Ryall by the throat, and was lying down with him on top of Parenti. In the struggle which followed between the lion and its victim, the carriage was tilted to one side, causing the sliding-doors to close, shutting in the lion with the men. The German was shaken

from his berth by the swaying of the carriage, and found himself in the hurly-burly on the floor, unarmed, for all the rifles had rolled beyond reach. Suddenly the lion leapt, with Ryall in its mouth, through one of the windows of the saloon, and disappeared in the darkness. The other two men escaped unscathed, but the Englishman was eaten.

Lieut.-Col. J. H. Patterson, in his book, "The Man-Eaters of Tsavo," narrates how man-eating lions played such havoc with the men engaged in the construction of the Uganda Railway that for three weeks they actually caused a total suspension of work at the rail-head. The matter was mentioned in the House of Lords by the third Marquis of Salisbury as an instance of the difficulties with which the pioneers of the line had to contend, the cause of the cessation of work being unique in the whole history of Imperial expansion. The railway, proceeding from Mombasa to the interior of Uganda, had reached a place called Tsavo, where a bridge had to be thrown over the river Tsavo. Here thousands of coolies and other workmen were peacefully assembled, when what Colonel Patterson

describes as "two voracious and insatiable man-eating lions" made their appearance. For nine months they waged warfare against the workers and all other folk in the vicinity. In the course of their campaign the lions killed and devoured among them no fewer than twenty-eight Indian coolies, in addition to scores of unfortunate African natives of whom no official record could be kept.

At first the lions were not invariably successful in their efforts to carry off a victim, but as time went on nothing stopped them. Of two men sleeping in the same tent, one would wake to hear the cry of his comrade, and see him dragged out of the tent by one of the lions before help could be rendered.

It was in vain that Colonel

Patterson and his assistants set traps and lay in waiting. The lions instinctively avoided them, and chose that part of the camp which had been left unprotected. We may well believe our author when he states that the beasts created a perfect reign of terror.

"In the whole course of my life," writes Colonel Patterson, "I have never experienced anything more nerve-shaking than to hear the deep roar of those dreadful monsters growing gradually nearer and nearer, and to know that some one or other of us was doomed to be their victim before morning dawned. Once they reached the vicinity of the camp the roars completely ceased, and we knew that they were stalking their prey. Shouts would then pass from camp to camp, 'Beware, brothers, the devil is coming!' But the warning cries would be of no avail, and sooner or later agonising shrieks would break the silence, and another man would be missing from the roll-call in the morning." How Colonel Patterson eventually slew the slayers is a chapter that is best read in the story which he himself so graphically tells.



THE HEAD OF A LION

HARMSWORTH NATURAL HISTORY

Even with the disappearance of these notorious monsters the peril from lions on the Uganda line did not end. The king of beasts still disputes the advance of man into his primeval domain, and in 1906 the following telegrams were successively despatched in the course of a day from the stationmaster of Simba to a superior down the line :

"Urgent.—Traffic Manager :

"Lion on platform. Please instruct guard and driver to advance cautiously, without signalling. Guard to advise passengers not to get out here. One man injured six o'clock by lion. Sent to hospital by trolley. Please send ball cartridges ; blank cartridges no good."

"Extra urgent :

"Pointsman surrounded by two lions. Has succeeded in climbing to top of telegraph pole near water tank. Immediate succour imperative. Special of Secretary of Administration is in dead siding, where he just now shot one lion."

At Tsavo, after the trains were running, man-eaters still turned up occasionally to put the fear of death upon the railway staff. Here is a message that was wired through by the stationmaster to Nairobi : "Direct driver of two down to enter my yard very cautiously ; points locked up ; no one can go out ; myself, sheds-man, porters all in office ; lion sitting before office-door."

The lion in captivity can be trained to perform various tricks. To say that it can be tamed is another proposition. With advancing years the temper of the animal becomes uncertain, and at the last it will turn and rend the man by whom it has for years been fed and petted.

Herr Hagenbeck, in his interesting book, gives several examples of the extraordinary memory possessed by these animals for men who have won their affections, and Herr Seeth, a famous trainer of, and performer with lions and other animals, once told me of an experience which supports these claims. Seeth was engaged to perform in Paris in a frightfully realistic spectacle. Lay figures padded with horseflesh were to be thrown to a number of lions in the arena, and Seeth was to make his appearance and quieten them just as they were rending the flesh from the dummies.

He had at the time only six performing lions of his own, but a dozen or more, already trained, were to be supplied. It is a common practice, though not a wise one, for trainers to take over animals trained by other men, and to incorporate them in their own troupe. Seeth fulfilled his part of the bargain, and his six lions were turned into the arena with the rest. The padded figures were thrown in, and the lions, scenting the flesh, sprang upon the dummies. The scene to be represented was suggestive of a martyrdom in the Colosseum in the days of the Roman emperors.

When the lions were busiest with the figures, Seeth opened the door and entered the arena. He had barely set foot inside the ring when his foot slipped on some damp sawdust, and he fell. One of the strange lions immediately pinned him down, smashing his thigh between its jaws. The others joined in at once, and there was a struggle over his body. But just then the oldest and most powerful of Seeth's own lions came to his assistance. Placing itself across his body, it fought his assailants, and a fierce battle waged between this lion and those which sought to destroy its master. The lion which had first attacked still had Seeth fixed by the thigh, which by this time was terribly injured, but the others were kept off. Effective assistance



A FINE SPECIMEN OF THE AFRICAN LION IN THE HAGENBECK COLLECTION

STORIES OF THE LION

from the outside was impossible, for Seeth had fallen with his body against the gate. An assistant, however, thrust a crowbar between the iron palisading, and with this, Seeth, who had his right hand free, delivered a despairing blow, driving the point of the bar through the jaw and into the throat of the lion which had pinned him, killing it on the spot. By wriggling he was able to change his position, and to enable his assistants to open the gate and drag him out. Nineteen weeks in a Paris hospital followed the misadventure; but, inasmuch as it was found unnecessary to amputate the damaged limb, he came out perfectly content, though he limped slightly to the end of his performing days, which were many and profitable after this hideous experience.

observations. He had one adventure with a lioness which does not appear in his pages, and it is worth recalling as showing how readily a lion will accept assistance when in difficulties.

At Stellingen Park, near Hamburg, Hagenbeck has laid out a great open space for his lions and tigers, where they roam at will. A wide and deep ravine divides them from the spectators, who are thus able to watch the animals. One warm afternoon in 1906, when there were in this open space eight lions, three lionesses, and three tigers, one of the lionesses made an attempt to reach the other side of the ravine, where crowds of visitors were assembled. She failed, and falling back, should have been able to retrace her steps to the jungle proper, by means of a passage provided for



A TRAINER WITH A GROUP OF LIONS AND TIGERS HE HAS TAMED

This is, so far as one is aware, the only authenticated instance of one of the great carnivores giving battle to its fellows for the protection of a human being. It is arguable, of course, that Herr Seeth may have mistaken the action of his favourite lion, or, at any rate, have misinterpreted it.

Lions which have acted in concert for the capture of a victim will, when that victim falls, fight among themselves for possession of the body. Seeth's protector may have been actuated by such an instinct; the protection afforded as the outcome may have been purely accidental. But Herr Seeth, who spent a lifetime in training and performing with lions, had no doubt upon the matter; he was certain that his big lion fought, not for possession of his body, but to protect him against the other lions, and he attributed his escape solely to his favourite.

One of the things which surprised Mr. Roosevelt during his African expedition was that the lion and the buffalo occupied the same bed of reeds during the daytime, the carnivore making no attempt to attack its herbivorous neighbour. Mr. Roosevelt, however, noted that in the locality there was abundance of food for the lion—ostriches, zebras, and various species of antelope. Experience has taught the lion that the buffalo is a formidable foe, hence he would not attack it except when hard pressed by hunger. The proximity of the lions and buffaloes is not, therefore, to be regarded as in any sense indicative of friendship between the two. In captivity, however, the lion strikes up strange friendships, and mates with a greater variety of animals than naturalists would have dreamed of had not Herr Hagenbeck published the results of his

such contingencies. But she was unable to discover the way back, and her repeated efforts either to get at the people or to return to her companions roused her to a high pitch of fury, and her excitement was naturally shared by the other animals. Suddenly Herr Hagenbeck made his appearance among the animals in the jungle, and descending into the ravine by means of a ladder, coaxed the stranded lioness back into the jungle.

In the angry state of mind to which fright and disappointment had reduced her, the lioness might have attacked her master, and her excited condition might have caused the others, out of sympathy, to behave with violence towards him, but he led her back without difficulty, and the rest of the animals appeared quite to appreciate the friendliness of his motives.

In striking up a friendship with some animal not of its own species, the lion may be actuated simply by a desire for companionship, or there may be material benefit to be gained from it. Possibly both considerations were at work in an alliance established between an old lioness and a terrier dog in the Dublin Zoological Gardens some years ago. The lioness lived sixteen years in the Gardens, where she reared no fewer than fifty cubs. Towards the end of her life she became inactive. Living in freedom, she would have been compelled to turn man-eater; in her cage she had no lack of food, but the penalty of her inactivity was persecution by rats. These animals, which are quite fearless, frequently haunt the dens of carnivores, in search of unconsidered trifles left over from the meals of the monsters. When a lion is in health he does not mind; at any quiet hour of the day one may see mice

popping in and out of the lions' cages at the London "Zoo." But when the Dublin lioness began to lose her activity, the rats turned their attention to her, and actually began to eat her alive, nibbling her feet as they nibble the feet of elephants. Herr Hagenbeck, it will be remembered, had three young and travel-weary elephants killed by rats biting holes in their feet and causing them to bleed to death.

When the terrier was put into the cage of the lioness she received it with a surly growl, and doubtless would have immediately destroyed it could she have caught it. But presently a rat appeared in the cage, and the dog, forgetting any fear which the presence of the lioness may have induced, sprang on the rat and slew it. By some process which really seems not unlike reasoning, the lioness at once recognised in this rat-killing terrier a valuable ally. She lay down and coaxed the terrier to her, and folded her paws about him. From that time till her death the dog slept on the breast of the lioness, enfolded by her paws, and so protected her rest from disturbance by her savage little enemies.

E. A. B.

THE TIGER

In spite of the difference in colouring, the lion and the tiger (*Felis tigris*) are closely allied animals, both agreeing in having a circular aperture to the pupil of the eye, and also in regard to the characters of the hyoid bones which support the tongue. Next to the absence of the mane in the male, and of any tuft at the extremity of the tail, the most important external difference between the lion and the tiger is that of colour. The general ground-colour of the fur of the tiger is rufous fawn on the upper parts and sides of the body, but the tint may vary in different individuals from pale rufous to brownish yellow, the under parts of the body being white, while there is also a variable amount of white on the face. This rufous ground-colour is striped transversely with black throughout the head, body, and limbs, the stripes being often looped; and the tail is ringed with black. The ears are black, with the exception of a large white spot.

These striking colours, which are fully developed at birth, are brightest in young and vigorous animals, gradually fading in intensity with advancing age; and it is stated that tigers inhabiting forest districts are the reddest in ground-colour (page 262). As rare exceptions, both white and black tigers are met with.

A white tiger, in which the fur was of a creamy tint, with the usual stripes faintly visible in certain parts, was exhibited in the menagerie at Exeter 'Change in London about 1820; a second example was obtained at Poona about 1902, and a third in Assam in the spring of 1899. All three specimens were of a beautiful creamy white colour, with faint indications of stripes. A perfectly black tiger was found dead many years ago near Chittagong, on the north-east frontier of India.

With the exception of a ruff of longish hair round the neck and throat of old males, which represents the

mane of the male lion, the hair on the head and body of the Indian tiger is generally short and thick, but it is more elongated and shaggy in the winter coat of the Manchurian tiger, which represents a distinct local race, *F. tigris longipilis*, or *F. tigris mongolica*. There is also a certain amount of variation in the length of the hair of the Indian tiger according to the season of the year.

The tail of the tiger, in both sexes, tapers regularly from root to tip, its total length being about half that of the combined length of the head and body.

When describing the lion, it has been mentioned that the skull of that animal may be distinguished at a glance from that of the tiger; and it may be added that a tiger's skull is, on the average, even wider and more massive than that of the lion. Moreover, in correlation with the more curved profile of the head of a tiger, as compared with that of a lion, the skull of the former has its outline more convex, while the inferior border of the lower jaw is also straighter.

The tiger stands lower on the limbs than the lion, and is thus proportionately longer in the body. In regard to the size attained by tigers there has been even more exaggeration than in the case of the lion; this being in great part due to the measurements having been taken either from skins after they had been removed and pegged out on the ground to dry, or from tigers which had been carried for several hours thrown across the backs of elephants, and had thus become considerably stretched beyond their normal length.

Full-grown male tigers usually measure from 5½ to 6½ feet from the tip of the nose to the root of the tail; the length of the tail being about 3 feet. In one example, the total length of which was 9 feet 6 inches, the length of the head and body was 6 feet 4 inches, and that of the tail 3 feet 2 inches. Female tigers are generally about a foot shorter in the length of the head and body than males. The height of a tiger at the shoulder varies from about 3 feet to 3 feet 6 inches.

The foregoing dimensions are taken in a straight line, but the usual mode of measuring a tiger adopted by sportsmen is to follow the curves of the body, when the dimensions will, of course, be somewhat greater; and it appears that most of the largest tigers on record have been measured in this manner. Full-grown tigers thus measured vary from 9 to 10 feet in length, and tigresses from 8 to 9 feet. Exceptionally fine specimens, however, may reach, or even slightly exceed, a length of 12 feet; 12 feet 2 inches being seemingly the maximum dimensions



THE BENGAL TIGER

ascertained with any approach to accuracy. Tigresses by no means invariably attain the minimum length mentioned above, an apparently adult example having been killed that was only 7½ feet long, while a second measured but 7 feet 8 inches.

Mr. G. P. Sanderson gave the weight of a fine male tiger killed by himself as 350 pounds; specimens weighed by Sir W. Elliot reached 362 and 380 pounds, and Captain J. Forsyth concluded that some unusually large tigers which fell to his own rifle must have weighed

THE CAT TRIBE: THE TIGER

from 450 to 500 pounds. Mr. W. T. Hornaday records a tiger measuring 9 feet 11½ inches in length, of which the weight was upwards of 495 pounds; the Maharaja of Kuch-Behar has killed tigers which are stated to have varied from 481 to 540 pounds; and one shot by Mr. F. Shillingworth, of which the length was 9 feet 10 inches, weighed a little over 520 pounds. The weight of a tiger depends, of course, largely upon the condition of the animal at the time of its death; and if a specimen under 10 feet in length will turn the scale at over 500 pounds, those of 11 or 12 feet, in equally good condition, must reach heavier weights.

Although mainly, if not entirely, confined to Asia, the tiger has an extensive geographical distribution on that continent and its islands. To the west its range is limited by the mountains of Ararat and the Caucasus, whence it extends along the southern shores of the Caspian—the ancient Hyrcania—into Northern Persia, the Herat district, and so into Turkestan. Thence it ranges over a large portion of Central Asia, embracing Southern Siberia, to a line some distance north of Irkutsk, and the whole of Mongolia as far eastwards as Amurland and the island of Saghalien; and its fossil remains have been obtained, in company with those of the mammoth, from the New Siberian Islands lying some distance within the Arctic Circle.

From Mongolia the range of the tiger extends southwards through China to Burma, Siam, and the Malay Peninsula; and also embraces the islands of Sumatra and Java, but not, it is said, Borneo. Across the Assam district, at the northern end of the Bay of Bengal, the tiger ranges into India, where it is found from Cape Comorin to the Himalaya, although unknown in Ceylon. The whole of the elevated plateau of Tibet forms an island in its distributional area into which the tiger does not intrude, and it is equally unknown in Afghanistan and Baluchistan, as well as in that portion of Persia lying to the south of the Elburz Mountains.

From this extensive distribution it is evident that the popular idea that the tiger is a tropical animal is erroneous. And it is even doubtful—in spite of the world-wide reputation of the Bengal tiger—whether those inhabiting the warmer regions are the most magnificent examples. In spite of this, the tiger is so intimately associated with and characteristic of India that it will always—and rightly—be regarded as the special animal of that country. Probably the absence of the tiger from Ceylon may be taken as an indication that the animal is a comparatively recent immigrant into Southern India, since most of the other Indian mammals are found on both sides of the Strait of Palk, dividing India from Ceylon.

Four races of the tiger are recognised by naturalists, of which the first is the typical Bengal tiger (*Felis tigris typica*), in which the pale areas on the body, head, and limbs are pure white, sharply defined, and of considerable extent, while there is only a short fringe of

hair on the cheeks, and practically none on the neck and throat. Another important feature is the absence of any marked lengthening in the winter coat. In many instances the development of the stripes is imperfect, but this cannot be regarded as a racial characteristic.

The Manchurian tiger (*F. t. mongolica* or *longipilis*) differs in the larger amount of white on the face, under parts, and the inner surface of the limbs, and likewise in the long, thick, and woolly winter coat.

The Caucasian and Persian race (*F. t. septentrionalis*) is distinguished by the presence of an abundant fringe of long hair on the cheeks, throat, and under parts; the bodily size being medium. This race takes its name from the very full development of the striping.

Lastly, there is the Malay tiger (*F. t. sondaica*), which is a small or medium-sized animal, agreeing with the Persian race in the character of its striping, but distinguishable by the indistinctness and small

extent of the white areas on the head and body, the absence of a fringe on the under parts, and the shorter hair on the cheeks and throat. In colour, the white areas vary from dirty to buffish white, and they are also ill-defined.

Although in some of the more thickly populated districts of India, especially those well supplied with railways, such as parts of Bengal, the Central Provinces, and Bombay, tigers have greatly decreased in numbers, or have well-nigh or completely disappeared, in the wilder and more sparsely inhabited districts they are still plentiful. Indeed, wherever large tracts of forest and grass-jungle remain in India, there tigers are to be found in more or less abundance.

In the fever-stricken swamps and islands forming the so-called Sundarbans of Lower Bengal, tigers are especially common; as they also are in the forests of Burma and Assam. Formerly they were to be met with in the grassy islands of the Brahmaputra, but the navigation of that river by steamers has led to a large reduction in their numbers. In the forests flanking the Eastern Himalaya, known as the Terai, tigers abound; and at times ascend the mountains to heights of six or seven thousand feet above sea-level, although they are unknown in the interior of the Himalaya. Towards the western end of the Himalaya, where forests are much thinner and the whole country is drier, tigers have gradually become less common; and in the Western Punjab and Sind they are either very rare or unknown. In parts of Java and Sumatra tigers absolutely swarm, and Dutch merchants at Padang, Sumatra, have stated that the arrivals of coffee from the interior were sometimes below the usual average, on account of the number of tigers infesting the route.

Although when seen within the narrow limits of the cage of a menagerie, or stuffed in the case of a museum, the brilliant colouring of the tiger appears extremely conspicuous, yet in the native haunts it is essentially of a protective nature. Sir I. Fayer



AN OLD TIGER IN THE LONDON ZOOLOGICAL GARDENS

observes that brilliant as is the general colour of the tiger, "it is remarkable how well it harmonises with the grass bush among which he prowls, and for which, indeed, until his charge and the short, deep growls or barkings which accompany it reveal his presence, he may be mistaken."

Indeed, the vertical stripes of tawny orange and black on the skin of the tiger harmonise so exactly with the broad blades of yellow grass, separated by equally broad lines of blackest shade, that it is often difficult to distinguish the animal from its surroundings when seen in its native jungle during summer.

Although there is a marked difference in the habits of individual tigers, according as they live on wild game killed in the jungles, or on domesticated cattle, or are man-eaters, yet all have certain characters in common. As a rule, the Indian tiger is solitary and unsociable, although at certain seasons of the year the pairs of males and females associate more or less closely. In all cases, the male consorts with a single female; but it does not seem to be definitely ascertained whether this union is permanent. Occasionally as many as four, five, or even six full-grown tigers have been seen in company; and it appears that these are always family parties, the cubs having remained with their parents till grown up.

Like lions, tigers are essentially nocturnal, lying concealed in the long grass or forests till evening, and then issuing forth for their nightly prowls. Their wanderings during the cold and wet seasons at least are considerable, and it is believed that at such periods they have no fixed abodes. During the hot season, when the country is burnt up with heat, and the smaller streams, pools, and tanks are dry, the range of the Indian tiger becomes much more restricted. At such times it takes up one definite "beat," haunting the banks of the rivers, and patches of long grass which are kept fresh and green by growing near water, or in swampy ground. And it is remarkable that when a tiger with a restricted beat is killed, in the course of a few months another will occupy its place, utilising the same lairs, and drinking at the same pools.

Grass-jungles and swamps are not the sole haunts of the tiger, which will select as a lurking-place clefts and caves in rocks, the shelter afforded by high banks, or the grass-grown ruins of the numerous deserted cities to be found in many parts of the plains of India. In many cases, one particular rock, or one patch of grass, is always inhabited by a tiger, while another, apparently equally suitable, has no such tenant; and in the plains, wherever tigers are met with, there will wild peafowl invariably be found.

Tigers are excessively impatient of the fierce heat of the dry season, and always try to shelter themselves from the burning rays of the sun. This impatience of extreme heat, in conjunction with their occurrence in comparatively cool climates, like those of Northern China, Manchuria, and parts of Siberia (page 20), where the winters are severe, is in favour of the view that these animals are somewhat recent

immigrants into a large portion of India. To aid in mitigating the terrible heat, tigers wallow in the shallow water of swamps and the margins of rivers, and then roll in the dry sand after their mud-bath. Such, at any rate, are their habits in the plains of Bengal, Assam, etc.; but it has been stated that on the Nilgiri Hills of Southern India tigers are never known to wallow in this manner. Not only does the tiger indulge in such wallowings during the hot season, but he is also an excellent swimmer, and will take readily to the water.

In the Brahmaputra, where reedy and grassy islands and sandbanks, locally known as *churs*, intercept the course of the river, tigers swim for miles during the night from island to island in search of prey, and, if unsuccessful, return at dawn to the mainland. They likewise display very similar habits in the Bengal Sundarbans, where they cross arms of the sea.

In spite of its predilection for water, the tiger can, at a pinch, endure thirst for a considerable period, even in the hottest weather. An instance of this is given by Mr. Sanderson, in which a pair of tigers was surrounded by nets in a small patch of jungle.

The weather was hot, the circle in which they were enclosed was only seventy yards in diameter, and the heat of the fires kept up day and night all round was considerable. Still, they existed without a drop of water for ten days, suffering from wounds half the time. A tiger can go much longer than this deprived of food without serious inconvenience.

Like lions, tigers are bad climbers, incapable of ascending a vertical stem, no matter what may be its dimensions. If aided by a sloping stem, or by a fork at some distance from the ground into which they can spring and thence obtain a fresh start, tigers, however, will occasionally attack sportsmen who are waiting for them in trees. It is also stated that, when caught by inundations, tigers will endeavour to escape by climbing.

Stems of trees, especially certain particular favourites in tiger-haunted districts, are marked by the vertical scorings in the bark made by the claws of tigers, these markings not infrequently extending to a height of at least ten feet, and thus affording a clue to the large size of the animals by which they were made.

The idea that tigers are in the general habit of springing appears to be a delusion, and it is seldom that they move their hind legs from the ground, except to clear a fence or other obstacle. When so inclined, they are undoubtedly able to spring to a considerable height; and one, at a single spring, pulled a native from a tree at a distance of eighteen feet from the ground. About fifteen feet is probably the maximum horizontal distance that a tiger can spring.

"The tiger's usual attack," writes Sir J. Fayrer, "is a rush, accompanied by a series of short, deep growls or roars, in which he evidently thinks he will do much by intimidation; when he charges home, he rises on the hind feet, seizes with the teeth and claws, and endeavours and often succeeds in pulling down the object seized."



TIGER IN THE ZOO WATCHING THE VISITORS

THE CAT TRIBE: THE TIGER

It seems only on rare occurrences that a tiger, when suddenly and unexpectedly disturbed, will fly at a human being; the fact being that a tiger seldom attacks actually to kill, unless it is driven or wounded in a hunt. Tigers frequently charge with a short roar if suddenly disturbed, but do not intend to charge home, and a shout from a native is sufficient to turn them aside, when they dash forward and disappear, probably as glad to lose sight of their foes as are the latter to escape from danger.

Unlike the noisy lion, it is exceptional for the tiger to attract attention by its roar. "Their usual call," writes Dr. Blanford, "is very similar to that of a lion—a prolonged moaning, thrilling sound, repeated twice or thrice, becoming louder and quicker, and ending with three or four repetitions of the last portion of it. Besides this there is a peculiar loud 'woof' produced when the animal is disturbed or surprised, a growl that it utters when provoked, and the well-known guttural sound repeated two or three times when it charges. When hit by a bullet, a tiger generally roars, but tigresses, at all events, very often do not; I have on three occasions at least known a tigress receive a mortal wound and pass on without making a sound."

With regard to the breeding of tigers, the number of cubs produced at a birth varies from two to five, although it is stated that there are instances where the litter included as many as six. When there are only two, one is a male the other a female; but this general equality of the sexes of a litter renders it difficult to

The food of tigers varies greatly. The typical jungle tiger lives chiefly upon deer, wild pigs, and antelopes; but it will kill also domesticated cattle, porcupines, monkeys, peafowl, and other small animals. Although full-grown buffalo and gaur are usually a match for it, young or feeble individuals often fall victims to its attack; and instances are recorded of young elephants being killed and eaten. Adult bull gaur are occasionally slain; the tiger, according to the report of the native herdsmen, inducing the bulls to charge time after time, when as they pass they are wounded by a blow on the flanks from its paw. That the male



THREE STAGES OF A TIGER'S GROWL

account for the large preponderance of adult tigresses over tigers. Tigresses appear to breed at all times of the year, young cubs having been taken in March, May, and October. Tiger-cubs, which require a period of about three years to attain maturity, remain with their parents for most of that time; and when several adult tigers are found together, the party is a family one. In captivity tigers breed much less freely than lions, and the cubs are far more difficult to rear. When caught young, tigers can be easily tamed, but are more intractable than lions when taken at a later age.

tiger will sometimes devour his own offspring is well authenticated; and Mr. Sanderson was informed, on what he considered good authority, of an instance where three tigers devoured another of their own species. The "kill" of tigers is frequently kept until it assumes a putrid condition; and, in addition to

carion of this nature, they will eat the decomposing flesh of animals other than those killed by themselves. The tigers dwelling near villages are, unless man-eaters, in the habit of living more or less entirely on the small native cattle, which are generally, and especially in the dry season, in miserable condition.

Late afternoon is the time at which cattle are usually seized by tigers when grazing in the jungles, although they may be struck down at any time of the day. If killed during the daytime, the carcass of the victim is left where it lies till evening. At nightfall, or perhaps earlier, the tiger returns to the "kill," and either begins to devour it at once, if the spot be sufficiently secluded, or proceeds to remove it to one more convenient. After he has satisfied his appetite, the tiger may either retire to a convenient resting-place in the neighbourhood, from which it can rush out and drive away jackals and other intruders from the "kill," or may completely conceal it under bushes and leaves, and seek a more distant lair in the vicinity of water. When it has recovered from the effects of its gorge, the tiger returns for a second meal; and in about three days the carcass will be reduced to little more than a skeleton. During the intervals between their meals, tigers are

sluggish and stupid, being with difficulty roused from their slumbers, and when so awakened are dull and indisposed to show fight.

Although it has been much exaggerated, the strength displayed by a tiger in carrying off his prey is enormous. The weight of the ordinary Indian cattle may be set down roughly at from 350 to 400 pounds; and although it is an error to suppose that a tiger can take a carcass of this weight and carry it in his mouth without letting any portion of it drag on the ground, at least at intervals, yet it is certain that he can carry such a load. Mr. Sanderson relates, for instance, how a powerful tiger took up and carried the carcass of a bullock through a dense thicket for about three hundred yards; while a smaller tigress carried one in open jungle for a shorter distance. As a rule, however, the bodies are dragged along the ground; and even this, when the nature of the surface in Indian jungles is taken into account, is a sufficiently formidable task.

It has been surmised that man-eating tigers, which generally belong to the female sex, were animals unable to procure other food owing to the effects of age. Although this is true in a very large number of instances, tigers may take to man-eating from other causes. Either wounds, or excessive fat, or the fact of a tigress having to bring up a family of cubs where food is scarce, may be the original reason for the adoption of this mode of life. All man-eaters were, it has been suggested, at first cattle-stealers, and gradually became accustomed to the sight and presence of man, and thus lost their instinctive fear of the human race.

When once a tiger has taken to man-eating, and has discovered how easily its victims are killed, it ever after hunts the same kind of prey, although only some confine themselves to this description of food. Those tigers which are entirely or mainly man-eaters inflict fearful havoc on the natives among whom they have taken up their quarters, an average-sized native of India forming by no means a hearty meal for a tiger.

All who have had to do with them are unanimous as to the extreme wariness and caution of man-eaters, which, for this reason, are the most difficult to kill of all tigers. The slightest rustle or whisper on the part of the pursuer is sufficient to put the man-eater on its guard; and it is marvellous with what sagacity these animals distinguish between an armed sportsman and a helpless unarmed native. The man-eater will seize an unsuspecting native by the neck, and trail the body to some sequestered spot, where the victim may be eaten at leisure and without fear of hostile intrusion. The hind quarters, thighs, and more fleshy portions having been disposed of, the remains are then deserted, probably for good, the bloodthirsty tiger preferring a fresh body for its next meal, which it will obtain in similar fashion at the nearest hamlet.

Formerly, before European sportsmen armed with rifles had access to most parts of the country by means of railways, whole districts in India were either depopulated

or deserted owing to the ravages of man-eaters; and the sites of villages abandoned from this cause are still visible in the jungles. Not infrequently, however, the cunning and caution of the man-eater baffles, at least for a time, all efforts of the European sportsman to encompass its destruction; while there are districts where one of these pests may continue its depredations for a long period without coming under the notice of Europeans. The destruction of human life by tigers,

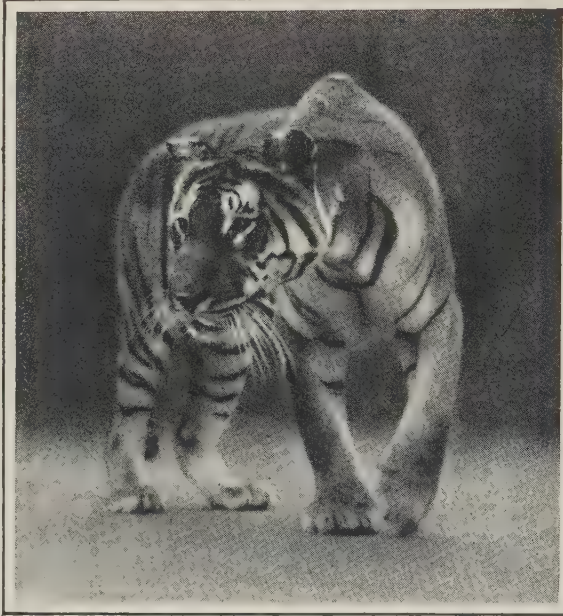
most of which are probably habitual man-eaters, is indeed still deplorably large, especially in the more thinly populated districts. As an instance of this, a man-eater which infested the neighbourhood of the station of Naini Tal in the Eastern Himalaya prowled about within a circle of twenty miles, and devoured on an average about eighty men per annum.

In order to rid themselves of these pests, the natives of India and other countries have had recourse to all kinds of traps and other devices. Among these, pit-falls used to be a favourite method. In Sumatra the pits are made in the form of an iron-furnace, wider at the bottom than at the top, and from about fifteen to twenty feet in depth, a sharpened stake being fixed at the bottom. The top of the pit is then covered over with branches and leaves, and so

perfect is the concealment that incautious sportsmen or collectors often have narrow escapes from falling into a pit. Indeed, one traveller was killed by a fall on the sharpened stake, after which that portion of the contrivance was forbidden by the authorities. Large mouse-trap cages for catching tigers alive were formerly used in certain parts of India, but were more successful in catching leopards than tigers. Poisoning the "kill" is also a method that has been more or less successful; while bows with poisoned arrows and spring-guns set in the tiger's path have also been resorted to.

In parts of the Mysore district the villagers are, or were, in the habit of surrounding tigers with nets, and then spearing or shooting them; this, except watching, being the only means by which they can be killed in covert which is too dense to admit of driving. In Orissa, and perhaps elsewhere, the natives construct a gigantic figure-4 trap loaded with a platform of heavy stones, that falls upon and crushes the tiger.

Several modes of hunting or shooting are adopted by Europeans and many of the native chiefs and shikaris. One plan, especially favoured by the shikari, who is less impatient of a night watch than most Europeans, is to build a platform, or *machan*, in a tree near the "kill" (p. 379), from which the tiger may be shot on its return visit, a variation of this plan being to construct the machan in any likely spot, and to tie up a goat, cow, or buffalo as a bait. The uncertain light prevailing at the time of the tiger's visit renders shooting from these machans far from certain. Throughout a large portion of Bengal, the North-West Provinces, Central India, and the Terai land at the foot of the Himalaya, where tigers are generally found in swamps and grass



A TIGER IN AN ATTITUDE OF SUSPICION

THE CAT TRIBE: THE TIGER

jungle—the grass in the latter being often from eight to ten feet in height—the common, and often the only practicable, plan is to beat the jungles with lines of elephants; the sportsmen either shooting from their howdas, or from machans placed in trees in positions commanding the ways along which the tiger is likely to bolt. In other districts, and more especially in parts of Bombay and Madras, tiger-shooting is often undertaken on foot; and it is in this dangerous sport that fatal and serious accidents are likely to happen, for no accuracy of aim or steadiness of nerve can always guard against or prevent the rush of even a mortally wounded tiger, which in its very death-throes may inflict a dangerous or fatal injury.

In many parts of India, as well as in Burma, the tiger is regarded by the natives with a superstitious awe which prevents them from killing it, even when they have the power. As might be expected, this awe is more developed among the credulous Hindus than among the Mohammedans. In all cases, however, the natives have no objection to the slaughter of the tiger by Europeans. Frequently the tiger is regarded as tenanted by a spirit rendering it immortal; and in many districts the animal is never mentioned by its proper name, *sher* or *bagh*, but invariably by some euphemism. Closely connected with this superstition is the avidity with which the claws, whiskers, front teeth, and the rudimentary collarbones of the tiger are collected and preserved as charms by the natives of many districts; although by others they are held to be deadly poisons and destroyed as soon as possible. For these reasons a tiger-skin with the whiskers preserved is a rarity.

R. LYDEKKER

MY EXPERIENCES OF THE TIGER

BY MAJOR F. G. ALEXANDER

After the Franco-German War a party of Communists entered Le Jardin des Plantes, in Paris, and removed a board over a tiger's cage, on which was written "Le Tigre Royal de Bengal," and substituted the description "Le Tigre National de Bengal." In doing so they accidentally corrected a popular error, to wit, that the Bengal tiger should be regarded as a superior beast. From the Sundarbans in Bengal to the banks of the Indus, and southwards to Madras, the tiger is virtually the same, and from personal observation and frequent discussion with brother hunters I do not believe that the Bengal tiger is materially superior to his distant neighbours.

At Baroda it was formerly the custom to pit dangerous animals against one another in a vast arena with high walls. Sometimes a rhinoceros and elephant fought for supremacy; at other times a tiger and wild boar; and in these combats the lion and the tiger were also confronted. It often happened that the antagonists sulked, and no amount of goading would cause them to do battle. I remember one case in which a tiger refused to face a boar, and surmounted the parapet, to the alarm of the spectators, who fled in terror.

In comparing the tiger and lion, as regards muscular strength and agility, the latter stands slightly higher at

the shoulder, but the jaws and the claws favour the tiger, which is also faster in its movements and can gyrate more quickly on its axis than the lion. On the other hand, a lion with a mane possesses defensive armour at a vulnerable point, namely, the throat, whereas the tiger is here poorly protected. A maneless lion or a lion with a small mane, either African or Indian, would fare badly against a full-grown Indian tiger. Relentless grip counts in the long run. Everyone knows what power a stoat possesses in this respect and that, in proportion to its size, it stands almost alone in the animal world, excepting perhaps certain crustaceans.

I have the dimensions of my largest tiger's skull; it is over 15 inches between nose and occiput, and over 9 inches broad; and the beast only measured 9 feet 8 inches in length. The tail was inordinately short. My longest tiger was 10 feet 1 inch in length—I measured him as he lay dead, from nose to tip of tail, without following the curvature of the body. His skull was only 14½ inches between uprights, and 8½ inches in breadth, but the tail was very long. The beast with the huge head was a thicket hill tiger. The tiger with the long tail was a man-eater of the plain, a perfect greyhound in appearance. I do not attach much importance to the weight of a tiger, as after a kill he might weigh heavier than a finer tiger whose belly happened to be comparatively empty. The average length of the tigers I have killed was 9 feet 4 inches, and that of the tigresses 8 feet 3 inches.

I have examined over one hundred carcasses of cattle, sambar deer, and nilgai that have been slain by tigers or tigresses, and almost in every case I have, by teeth and claw marks, ascertained the following facts: The tiger's forearms encircled the fore part of the body—one claw mark was over the spine, the other round the chest, and the great jaw fangs invariably left their impressions behind the occiput and on either side of the vertebræ. Besides such wounds there were marks of fangs on the throat, but it stands to reason that, to dislocate the vertebræ, it is necessary to grasp the spinal cord. Dislocation can hardly be effected by gripping the flabby throat of a buffalo

or nilgai. I have always concluded that the throat was seized after dislocation from above.

Whether the object was to drink the blood of the victim or to ensure death, I cannot say. After the tiger has killed his prey he invariably drags the carcass to a secluded spot and begins his meal on the hind quarters of the animal, the fore quarters forming the last portion.

The carcass is dragged sideways and sometimes for a considerable distance, often over two hundred yards. This dragging is not always conducted on an open plain, but through formidable bushes of karindah and eucalyptus, and even over rocks, and when the body is finally deposited, the tiger is not far off, unless he is particularly shy, and has been often hunted, in which case he deserts it. I have watched a tiger near a kill, and seen vultures and kites swarming in the vicinity, but as soon as a vulture approached the body, the tiger came down with a hoarse cough, not quite a roar, and warned the intruders to clear out. For thirty minutes



AN INDIAN TIGER IN THE DUBLIN ZOOLOGICAL GARDENS

HARMSWORTH NATURAL HISTORY

and more this exhibition between hungry vultures and the vigilant tiger lasted, but the carnivore would not allow any bird to touch the prey. Incidentally, I may say that valerian oil, which is known to attract the domestic cat, is quite inoperative (in my experience) when placed on kills or around panther traps.

In my jungle experiences I have been an eye-witness of various interesting encounters. I was too late to befriend a doe sambar which was being pulled down by wild dogs; the poor beast was at its last gasp. There were four dogs about the doe, which had taken to water as a final resource. I have watched, with my glasses, stag sambar fighting on the mountain side, and many stags which I have killed bore marks of old and recent battles, but the most exciting affair occurred in January, 1892. My men reported that from a conical hill at Kotra, in the Asseerghur jungles, they had witnessed a duel between a large tiger and a full-grown boar, and that the battlefield was within a mile of my camp.

Out of curiosity I went to the spot, and on the sandy plain the story of the struggle was clearly written. The boar had originally been lying in a pool contained in a nearly dry watercourse. The tiger had been taking an evening stroll, and the pair had suddenly confronted each other. The boar had at once charged the tiger, which retreated. The boar then left the river bed, and deemed it safer to reach the open plain. The tiger followed, but whenever it approached within twenty yards, the boar immediately faced and charged the tiger; these tactics continued for nearly a mile, within which distance the boar charged six times. I eventually found the spot where the tiger gave up the chase, and moved off at right angles to the boar. There is no beast for which the tiger has such respect as the wild boar with its razor-like tusks. The former is a thin skinned animal, and a rip from an active five-year-old boar would cause a tiger to shed its bowels. The wonderful instinct which inspires respect between fighting animals is a study in itself.

Many times at daybreak, when I found the tracks of a herd of gaur, I observed the footprints of one or two tigers in the rear and on the flank of the herd. The bulls, on discovering the presence of the stalkers, at once turn and charge down on them. I have never

known an instance of a tiger conquering a full-grown gaur bull in prime health and condition, although a pair of cows, with calves, isolated from the herd, affords an opportunity which a tiger will seldom miss. I have seen a herd of domestic buffaloes charge a wounded tigress, and cause her to fly for her life. Footprints have proved that even five domestic buffaloes can drive a tiger away. A tiger had attacked one which was badly claw-torn, but the buffalo's friends were in time to prevent the final *coup*, namely, dislocation of the neck.

Concerning the tiger's coloration, my field of observation has been limited to Rajputana, Central India, and Bundelkhand, the jungles in which may be called "open jungles." The colour of all the tigers killed by myself and by brother sportsmen has, with two exceptions, been of a light red ochre. I once lured a cave tiger from its lair before sundown by tethering a bleating goat to a post in front, and within twenty yards of the underground cave. The incident occurred in the Asseerghur jungles. The colour of that beast was dark red ochre, far darker than that of any other tiger I ever killed.

I have seen Siberian and Chinese skins, and have killed tigers during the hot weather, monsoon, and cold weather; and as regards the length of their hair, I have found very little difference between a cold-weather tiger and a hot-weather tiger. There was, however, one exception. In Pertabgurg territory—which is within twenty miles of Neemuch—on one eventful Sunday I killed an adult male tiger. Judging by the teeth, he was very old. In length he was only 8 feet 1 inch, but his fur was quite an inch long all over the body; his colour was ruddy ochre, the ruff round the neck was particularly full, and his whole appearance led me to regard him as a dwarf-like specimen. If the skin had been exposed for sale in a furrier's shop, it would have been accepted as a Chinese or Siberian specimen. This uncommon beast was killed in the autumn of 1888.

There is no doubt that in dark jungles, such as those of the Siwaliks or the Dun forests, animals' skins assimilate themselves to the localities wherein the beasts live. That is Nature's general rule, but in open



A NEPALESE TIGER RESTING AT FULL LENGTH

THE CAT TRIBE: THE TIGER



SHOOTING A TIGER IN INDIA FROM A MACHAN, OR PLATFORM

jungles the pigment of the tiger's skin is invariably light. The Beemashunkur, Canara, and Belgaum jungles contain darker-coloured specimens, and I have seen skins from them all which were, on the average, far ruddier than the thirty-one I have obtained and a dozen more which I have seen killed. Black-and-white tigers are but freaks of nature, and can no more be accounted for than can albino blackbuck or black panthers.

In the markings of tigers and tigresses I have noted that the black markings on the body and belly are broader on the male, and that the double black band often surrounds an island of white or ochre, whereas in the tigresses such "surroundings" are by no means so common.

With reference to the lobes of a tiger's liver, natives are under the impression that the years of a tiger or tigress can be measured by the number of liver lobes. I have counted them frequently, and I attach extremely little value to the native belief. In one tiger in first-class condition, I have found as many as fourteen lobes; in another, stricken in years (by examination of the teeth), the number has been fewer; so I have come to the conclusion that the animal with many-lobes has earned them by assiduous purveying, and nothing else.

In the case of the Suliman ibex, fairly accurate data as to the animal's age can be obtained from the number of ripples, or what may be called shallow corrugations, on the horns, but in the case of a tiger's liver the size of liver and lobes is due to continual gorging.

Coming now to consider the case of the "man-eater," why does a tiger prefer human flesh to other food? This perverted taste is due to three causes—prolonged hunger, accidental circumstances creating the taste, and

old age and consequent inability to pursue game and kill cattle—the decay of nature inducing a condition in which flesh-eating animals often find it difficult to pursue their usual prey.

The late General Probyn was a great hunter, and roamed the Asseerghur jungles. One day in the early 'seventies he went out at midday and shot a stag sambar. The head and skin were sent to his camp, and the beaters were left to divide the meat. The sun was setting, and they returned to camp loaded with food, excepting one man, who remained rather late over the carcass. As he went home he was met by a tiger, who smelt fresh meat. The animal was hungry, and attacked the native, and, finding the meat insufficient, ended his meal with the body of the carrier. From that day that tiger became a man-eater.

Human flesh is an acquired taste, but, once acquired, is much appreciated by the feline race. Tigers in their infancy are fed by their mother on cattle, game, and such-like, and rarely depart from their usual menu. An Erinpura man-eater which devoured several post-runners, and was eventually killed by Dr. Spencer, was in good condition, and it is an error to suppose that because a man-eater lives on human flesh he must necessarily be mangy. In cases of man-eating tigers which have, owing to years of infirmity, developed a liking for man as food, the manginess is due to old age, and nothing else.

The only man-eater I ever shot was in the pink of condition; but he was not a total abstainer from cattle, otherwise I should never have bagged him. In his belly I found pieces of broken glass bangles which had belonged to some poor woman in a far-away village. In killing such scourges, it is very necessary, nauseating though it is, to dissect, and make sure that you have, beyond doubt, removed a public nuisance.

HARMSWORTH NATURAL HISTORY

In every jungle I have visited I have observed that pig, porcupine, cattle, sambar, and nilgai form the principal diet of the tiger. The porcupine in its wild state runs far faster than people suppose; but the tiger is fond of porcupine. He smashes the rodent's back with his fore paw, and frequently suffers for it, as I have found the ends of porcupine quills in the fore-arms of tigers I have killed. I also know of a case on Mount Abu where a tiger died through trying to swallow a bit of porcupine which included quills. The quills transfixed the tiger's gullet, and he perished.

Tigers, like crossing-sweepers, fix themselves on a pitch, and from this as centre generally limit their roamings to a radius of twenty miles. I do not make this statement without reason, as I have hunted a tiger for weeks, and, owing to footprints which I could distinguish from others, I have found that the area traversed corresponds, as a rule, to that mentioned. When one tiger is killed, another invariably adopts the pitch, roaming in the same circle and over the same ground as his predecessor. I have often known to a day from natives when a tiger or tigress might be expected to return from a distance and kill a tethered buffalo. There may be several tigers moving in one particular region, but, as a rule, they hunt in separate ravines and river beds.

The cattle-lifting tiger is timid to a degree, but his boldness at times, owing to hunger and disregard for the presence of natives, is remarkable. I once instructed my head shikari to go to a ravine frequented by a tiger and select a spot to tie up a buffalo. The shikari met the tiger in the ravine. The creature stood and looked at him for a time, curled his upper lip, and slowly walked away. If a European had been there, the tiger would have galloped off.

Another instance of the tiger's utter contempt for natives may be recorded. There was a certain water-course wherein a tiger was wont to wander, and, having nothing on hand, I went out with two trackers and followed the spoor. From 10 a.m. till 4 p.m. I followed the footprints, and, in disgust, left them, as I thought the beast had gone far away. I was at the time within a mile of my camp. I left the trackers, and they eventually came home and reported that as soon as I had left them they found the tiger drinking at a pool. It simply snarled when it saw the trackers, and quietly walked away. It took me six weeks to kill that beast, and cost me ten pounds in buffalo bait.

The animal's swimming powers are well known. In the river which flows beneath Punna in Bundelkhand are several small islands. When a hunt was contemplated, a buffalo was tied up to a tree on the bank. When the tiger captured the bait, it swam out into mid-stream and deposited the carcass on an island covered with jaman bushes and grass. Elephants were then driven

into the river, and the great cat invariably returned by the same route to the bank, where sportsmen on machans awaited it. A tiger swam, years ago, from the caves of Elephanta, across Bombay Harbour, towards the island of Bombay.

The tiger's eccentric movements are also notorious. One night a tiger crossed the bridge of boats at Benares, and entered the town, where it was killed by the superintendent of police from the roof of a native's house. For fourteen months a tiger was a lodger below a village, some miles from Baroda. The Brahmin patel ordered that it should be left unmolested, and supplied with food daily. Unfortunately, the patel's son took liberties with the beast, and threw uneatable offal at it, which resulted in the death of the man and also in that of the sometime tame tiger, which was killed by the late General Nuttall.

Tracking game is a fascinating pursuit, the art of which is far from easy to master. The spoors, or foot-

prints, of the male tiger are round, those of the female are oval. Once only was I deceived in this respect. The tracks of gaur, sambar, leopard, antelope, and gazelle are marked by broadness of track in the male, and by narrowness and elongation in the female. The tiger's footprints must also be studied. I was at one time after two separate tigers, one of which had a scar across what I will unscientifically call the back cushion of his fore paw, whilst the other's footprints were perfect. They both had the same beat, but one tiger was far larger than the other.

This I inferred from various things. Watch a cat, and you will observe that his fore paws smack the ground; the hind paws simply drop on the ground. Round the fore paws of a very large tiger treading on the ordinary "pug dundy" (footpath) you will find that the sand or earth has been blown away, and a ditch created around the

footprints by the concussion of the fore feet. The larger this ditch is, the larger the tiger will prove to be. The fore feet are for striking game, the hind legs are stiff and sinewy for galloping. No concussion ditch will be found around the impressions of the hind feet of the feline race.

Though tigers are uncommon in Sind, they existed on the banks of the Indus in 1877 before the great Kussmore barrage was built to stop the constant inundations round Jacobabad and Shikarpur. Firing the grass was the method usually adopted to drive them into the open. The grass was in places over 10 feet high, and such firing was attended with great danger, and I knew some sportsmen who escaped with difficulty from the flames, their weapons being consumed in the fire. I have been informed by an officer who was on the Afghan Boundary Commission that on the banks of an Afghan river he found tracks of wild boar and tiger, and that he shot a lot of pheasants from the same swamps.



SIZE OF THE BENGAL TIGER AND MAN COMPARED

STORIES OF THE TIGER

I have twice discovered five tigers together, once on the western slopes of Mount Abu, and once in the Udaipur jungles. On the latter occasion a wounded tigress was lying in a patch of grass 60 yards long by 30 yards broad. The grass was barely 4 feet in height, but so perfectly was the beast assimilated in colour to its surroundings that it required forty pairs of keen eyes and a search for ten minutes to find it. There were ten men in trees and on the high banks of the river bed; but a quiescent tigress in long grass is most difficult to locate. At last a young Bheel discovered the beast, and I was glad to slay it, because it had maimed a tom-tom (drum) beater for life. The tigress, as it proved to be, had been wounded by a young engineer a fortnight before I arrived on the scene, and when wounded made a leap after a native who had sought the protection of a sal tree. I measured the leap by the claw marks, and it was exactly 14 feet in height. That is the highest performance I can vouch for.

Referring to the bone-licking properties of a tiger's thorn-surfaced tongue, it may be interesting to state that I have often sliced off the surface from the raw tongue with a razor, and carbolised it. When it is dry, if you draw the surface across the hand you

stones at him from a distance before drawing too near to the recumbent body. The late Colonel Heyland once shot a tiger in the Abu jungles, and as he neared the animal with an unloaded rifle the tiger rose and ran away, and was never seen by him again. Probably a bullet had only temporarily stunned the beast. In attacking game the tiger's favourite hour is daybreak, when sambar and wild pig are returning from the plain—where they feed during the night—to their mountain fastnesses.

Tigers hunt by sound, scent, and sight. I have watched a distant tiger through glasses, with its ears pricked up, paying particular attention to the bark of a more distant sambar. Once when fresh sambar meat was hanging in my tent, in the cold weather, a hungry tiger galloped backwards and forwards in the pale moonlight with its hoarse cough of rage, to the distress of my followers. On examining the tracks in the morning I found that it had been within two hundred



A GROUP OF TIGER CUBS IN THE HAGENBECK COLLECTION

will recognise the cleansing powers of the tiger's tongue. Blood can easily be drawn from the hand by a too rapid movement. Tiger fat, by the by, is prized by natives as a cure for rheumatism.

In all jungles there are sentinels which denote the presence of the feline race; but the most acute detective is the kakar, or muntjac. The muntjac has two calls, one a salutation to his wife or family, another a sharp bark of danger, which the natives term "The khubberdar pukar" ("Take-care cry"). When the kakar thus calls, you may be sure that a tiger or panther is about. Monkeys and peacocks are rather indifferent to a quiescent tiger, but when he begins to move they swear at him continually. From tree to tree monkeys follow a tiger's movements, shaking the boughs and exhibiting intense hatred.

Tigers generally attack cattle at sundown; my men have frequently seen them moving towards a tethered buffalo at that hour, and informed me of the fact. They likewise watch the "lowing herd wind slowly o'er the lea," as it moves homewards to the village, and the devil takes the hindmost straggler.

There is great danger in approaching a tiger which is apparently dead. It is always desirable to throw

yards of my tent; it did not dare to approach nearer, but it gave vent to its wrath and hunger by coughs and hurried gallops to and fro.

I have seen a tiger hunting sambar by moonlight, and have lost two tigers by coolies smoking pan cigarettes too near a kill, when the tiger was busy on the carcase, which it left and totally abandoned. I have also watched a tiger hunting sambar by sight in the early morning, and I think other hunters will endorse my opinion that the eyes, ears, and nose of the tiger are wonderfully acute, for by the senses of sight, hearing, and smell it exists. All animals such as tigers, panthers, hyænas, jackals, and sambar talk louder when the weather is cold. F. G. ALEXANDER

STORIES OF THE TIGER

Despite the improvements in the modern gun, the man who hunts the tiger must be prepared at any moment to find himself being hunted. The man-eater needs no provocation to attack, though the cattle-thief may seek to avoid an encounter in the day, whatever its instinct when the sun goes down. Sir Maurice Gerard, who had singularly good fortune in his campaigns against tigers in India, narrated one or two

dramatic accounts illustrative of the rapidity with which the tiger changes from fugitive into pursuer.

One such instance cost the life of a friend with whom Sir Maurice was hunting in the Central Provinces. The former discovered a tigress sheltering in a ravine from the glaring noonday sun. Upon being disturbed, she bounded out as though to attack him, but this was only a characteristic feint; at the last moment she swerved, and dashed past him. As she did so, the Englishman shot her through the body, but too far back to render her inactive. The tigress continued on her course for a few lengths, then doubled back and charged.

The hunter was knocked down and twice rolled over, then suddenly released. Possibly the pain of her wound made the tigress drop him; for, as he struggled to his feet, and cried out to Gerard for assistance, she lay down and watched him. Sir Maurice, running up, had no difficulty in despatching her with a single shot. But with such suddenness had the charge of the tiger been made that he was unaware that any ill had befallen his friend. The latter proved to be in desperate plight. Although he had felt nothing more than the shock of the blow which knocked him down, and the attack had lasted but an instant, he was found to have been clawed in the left arm and shoulder, and bitten through the small of the back, and in the right knee and left calf; the injuries three days later proved fatal.

Sir Edward Bradford, with whom the late King Edward VII., when Prince of Wales, afterwards shot his first tiger, is one of the few men who lived to tell of the terrible ordeal of being mauled by one of these ferocious and powerful beasts. A tiger, already wounded, managed momentarily to elude him as he lay waiting to finish it. Leaving the thicket in which he had been concealed, he peered down into the bed of the watercourse along which the tiger had been making its way, but discovered, to his horror, that the tiger had ascended unseen to his own level, and was at that moment stalking him. He tried a quick shot, but a twig getting under the hammers of his gun caused both barrels to miss fire.

Jumping down into the river bed, he sought safety in flight, hoping to escape by diving into one of the deeper pools of the shallow stream. The tiger, however, was too quick for him, and came on at his heels. He dodged it once or twice round a boulder, but it sprang open-mouthed at him, and seized the left arm which he thrust forward to defend his head and neck. The brute threw him to the ground, holding him fast, and began slowly to munch his arm upwards, pulping it to beyond the elbow.

Sir Edward, with marvellous nerve, made no attempt to wrest the limb away, realising that his doing so would merely cause the tiger to grip him with still more terrible force in a vulnerable spot. He lay quite still, therefore, until a courageous orderly, creeping up with a spare gun, blew out the tiger's brains. It was midday, and the scene of the misadventure was seventy miles from surgical help. A messenger was sent on ahead to summon assistance, and the victim was carried down all night on a litter, meeting the surgeon at ten o'clock the next morning. In the blazing sun, sheltered only by an acacia tree, the arm was

amputated at the shoulder, without anæsthetics, and the heroic sufferer recovered, to render forty years' valuable service to the State.

The Chinese have a saying: "The Koreans hunt the tiger during one half of the year, while the tiger hunts the Koreans during the other half." That the tiger lives up to his share of this arrangement there is not the least doubt, but that the Koreans are equally assiduous on their part is more open to question, as Lord Curzon found. The King of Korea maintained a body of royal tiger-hunters, who employed the mouse-trap plan, of which we read on page 376, baiting it with a live pig. The natives themselves, however, are generally satisfied if they can keep the tiger at a distance. They dare not venture abroad alone at night, but go in bands, brandishing torches and beating gongs. While Japanese troops were in Korea they had no need to fear that men would desert or deliberately straggle from headquarters; the Korean tiger is too notorious a snapper-up of the unwary to make such carelessness profitable. In the winter the beast does not wait for stragglers, but will stroll into Gensan at night and pick a victim for himself, much in the same way that the lions picked their men in the railway camp at Tsavo.

Lord Curzon may count himself lucky not to have made a closer acquaintance with one of the giants of the family. While he was staying at Chang An Sa, the Korean name for "the Hall of Eternal Peace," a noted Korean monastery, he was informed that a tiger patrolled the quadrangles of the establishment every night; and himself was able to trace the spoor of more than one tiger which had been stalking within speaking distance of the place where he slept.

Manchuria has not yet contributed her due share to the literature of the tiger, though the animal abounds in the land. Wild boar, bears, and antelope are among his neighbours, and from these he has choice of diet. But the man-eater is not uncommon. The natives pluck up sufficient courage occasionally to avenge the outrages perpetrated by the great cats, and a curious official record of their exploits exists

in the consular return of goods exported in 1898-99, in which year they sent forth fourteen tigers' skins, value £15, and seventeen hundredweight of tigers' bones of the value of £133. These figures by no means represent the full tale of the campaign against the Manchurian tiger, but cover only the goods exported through Newchang.

It was a Manchurian tiger which became one of Herr Hagenbeck's chief favourites at the famous Hamburg establishment. A giant beast, it was as tame as a kitten, and used to accompany its master into his sitting-room. Herr Hagenbeck ascertained that the animal had been brought up at liberty at Vladivostok for over a year after its capture as a cub, and that it had never done any harm. If he passed its cage without first caressing and speaking, it would call him with a mewing sound. Sir Maurice Gerard kept a tiger at Goona until it was as big as a panther. She went about at liberty, and would push open his door and lounge up to him to be patted, or to have a game of romps with his dogs. Her tenderness with puppies, he says, was extraordinary. The puppies were attracted, rather than frightened by her. They would



A NEPALESE TIGRESS

THE CAT TRIBE: THE LEOPARD

gambol up in the blundering way peculiar to them, throw themselves down on their backs, "and worship her." Though she would often take the head of one of them into her mouth, at the first squeak of her playfellow she let it go, and never inflicted real pain.

In consequence of the presence of visitors, it became necessary to secure the tigress, and she was chained up under a mango tree, where something of primitive nature showed itself. For one morning the grooms found her crouched over the body of a man, who, when she was coaxed off, made a bolt for the jungle, and was never seen again. It is supposed that he was a thief or a trespasser who had intended to take a short cut, unaware of the presence of the tigress.

These two experiences corroborate what animal trainers tell us of the nature of the tiger which has been brought up in association with man. The amateur observer is apt to attribute to the tiger the most impulsive ferocity; the animal trainer, writing or speaking for publication, takes the opposite extreme. In order to impress the public with a sense of his safety in the arena with wild beasts, and perhaps also a little from vanity, he declares that the performances are practically devoid of danger to the right man. But these so-called tamed animals never are really tamed. Trained they are, wonderfully trained, but never tamed. Not the most inspired of trainers can be sure that some unexpected accident may not kindle the rage of his pupils and lead to his being torn to pieces. Herr Hagenbeck mentions his wonderful "happy families" of carnivores and herbivores, and they are truly a triumph for his art and discipline; but Herr Seeth had a similar animal circle, which was occasionally broken by the lions killing the boarhounds which were part of the show, or eating the Shetland ponies which figured in the tableaux.

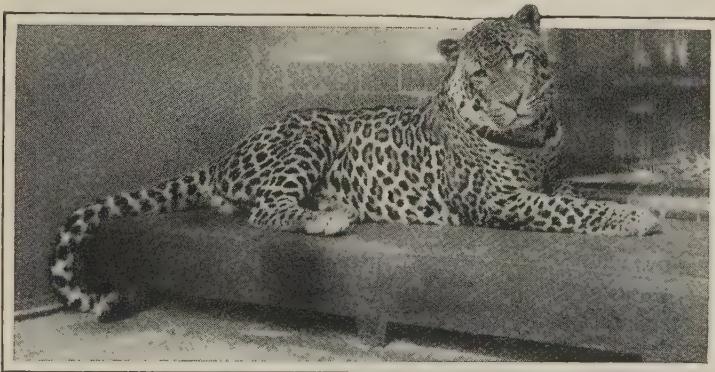
But that some of the men who train lions and tigers have a supreme contempt for the animals which they break to tricks is indisputable. I once had proof of this during a private rehearsal, at which a gigantic tiger was being trained to ride on horseback. The horse wore a huge saddle of leather which covered him from crupper to ears, and the business of the tiger was to leap from a pedestal to the saddle as the horse cantered round the arena, and back again to the pedestal, at a signal from its trainer. The latter was not the proprietor, nor the man who showed the animal in the ring, but a weedy-looking specimen of humanity, who might have been mistaken for an unprosperous ostler. And this modest fellow was, behind the scenes, king of the beasts of this very remarkable exhibition.

The training of the tiger was carried on with as little regard for the inherent ferocity of the brute as if it had been the most docile of poodles. It did not appear to object to the exercise, and there was not a suggestion of force employed, though a workmanlike stick and a heavy sjambok lay ready to hand. The arena was one of those domes of steel with which such performances have familiarised us, and in the building proper men talked or went about their affairs with absolute unconcern for the business within the railings.

The tiger did its part so well that it might there and then have performed in public. It landed light as a kitten upon the back of the slowly cantering horse, and came back to the pedestal just as unerringly, with its great pads outstretched like gigantic clawed mushrooms. Of course the trick was simple to the tiger. To a beast whose nature it is to spring upon and hold to the back of fleeing prey, this alighting upon the ample leather saddle of a particularly broad-backed horse was an exercise in which it could not make a mistake. The return jump from the back of the moving horse to the pedestal offered no greater difficulty. The feature of the performance consisted in one of the fiercest animals in the world submitting to the will of man, attacking neither him nor the horse, though in leaping upon the back of the latter one would have thought that instinct must have called up in the brute the desire to strike one blow for a meal.

The strangest part of the morning's doings came when a photographer appeared, and, thrusting the lens between the railings of the arena, desired to photograph the tiger. The latter, called up to his pedestal, did not like the look of the camera; and the movements of the photographer as he popped his head under the black cloth, then suddenly reappeared, excited the animal's surprise, if not displeasure. But

the trainer was equal to the emergency, and it was here that his absolute disregard for the nature of the beast with which he had to deal was most clearly demonstrated. He put one restraining arm round the back of the tiger as it squatted on its pedestal. With his free hand he drew from his pocket a red handkerchief, and, screwing it up, waved it about to the left of the tiger. The latter mistook it for a piece



THE WEST AFRICAN LEOPARD
Photograph by W. S. Berridge

of raw meat, became for an instant all attention, and prepared to spring for it. That instant's pause gave the photographer his chance, and the camera clicked. Then the trainer gave the tiger a pat, pocketed the deceptive red handkerchief, called the animal down from its perch, and unceremoniously bundled it off to its den. It all seemed so simple that one could not help fancying how easy it was to train this prince of cats.

Trainers do wonders with supposed untamable beasts, but they have to admit that they are dependent on the temper of the brutes, and that that temper may be aroused without any warning by some trifling event which could not possibly have been foreseen. E. A. B.

THE LEOPARD

The third in point of size of the Old World cats is the leopard or panther (*Felis pardus*), a species closely allied to the lion and tiger, from which it is distinguished by its fully spotted coat and inferior dimensions. In many works, written more from the sporting than the purely zoological point of view, two species of large spotted cats are recognised as inhabiting Africa and India, to the smaller of which the name leopard is restricted, while the larger is known as the panther. Although there is an enormous difference between the smallest and the largest of such spotted cats in point of size, yet the transition from the one to the other is so

gradual and complete that, in a large series of specimens, it seems impossible to say where leopards end and panthers begin.

There are, nevertheless, several more or less distinct local forms of leopards, which are best regarded as races of a single variable species. The spotted coat of the leopard being its most distinctive feature, the animal (in common with the hunting leopard) is known to the natives of India as the chita, meaning "spotted"; the leopard, on account of its larger size, however, being often distinguished as the chita-bagh, or "spotted tiger." By Europeans the name of chita (or cheetah) has been very generally restricted to the hunting leopard, but since there is no justification for this use, it is preferable to refer to each of the two species by its English title. The ground-colour of the fur of the leopard is subject to considerable individual variation, but is generally yellowish fawn, with a more or less marked rufous tinge, becoming gradually lighter on the flanks, and thus passing into pure white on the under parts.

The spots, which are variable in size and number, take the form of rosettes, and consist, on the upper parts, of an irregular black ring (nearly always incomplete), enclosing a light central area, which may be of the same tint as the general ground-colour, but is not infrequently darker. On the head, lower portions of the limbs, and flanks (where they are brownish), the spots have no light centres, and are smaller, but the extent of the area covered by these smaller solid spots varies to a considerable degree, according to race, if not, indeed, individually. The tail, of which the length may vary from rather more than one-half to about three-quarters that of the head and body, is likewise spotted throughout the greater part of its length; but at and near the tip the spots become larger and fewer, and tend to form more or less nearly complete rings. In leopard cubs the colours are not so well defined or so brilliant as in the adults. The hair on the head and body is generally short and close, but tends to become longer when the animal inhabits colder regions than usual, and that on the tail and under parts is always longer than the rest.

Indian leopards, forming the typical race of the species, have the rosettes large and the small solid spots mainly restricted to the head and limbs. Leopards approximating more or less closely to this type of marking are found in Northern and Eastern Africa, but in the rest of that continent leopards in which a large number of the rosettes on the neck and shoulder tend to break up into smaller solid spots form the prevailing type. In Somaliland occurs the smallest of all leopards (*F. pardus nanopardus*), in which the spotting is largely of this small solid type, while the ground-colour of the fur is greyish white. Perfectly black leopards are not uncommon, and appear to be more general in the hills of

Southern India, Asia, and the Malay Peninsula and islands than elsewhere. The skin of such black specimens, when viewed in certain lights, exhibits a kind of "watered-silk" appearance, due to the presence of spots, in which the hair has a deeper tinge of black than elsewhere. That such black leopards are nothing more than colour phases is proved by instances where a female of the ordinary colour has given birth to a litter among which was a black cub; one such instance having taken place at the Zoological Gardens at Amsterdam, where a female gave birth to one spotted and one black cub.

It appears, however, that male and female black leopards mated together will breed true, the experiment having been tried in India, where a pair of these leopards gave birth to two litters of wholly black cubs. In 1908, at one of the meetings of the Zoological Society of London, there were exhibited certain dark-coloured leopard-skins from Abyssinia, two of which were wholly black, while the others were what is called melanistic. These skins were made up into rugs, and it was also mentioned that other specimens of a similar character, reputed to come from Abyssinia, had been received on previous occasions in London, and treated in the same manner. The melanistic skins merely showed a deepening of the general colour, more especially on the two sides of the dorsal line; and an intensification of the same feature had evidently led to the production of complete melanism in the other two skins, both of which, when viewed in certain lights, revealed the existence of the normal black rosettes. In regard to general colouring these skins are, in fact, of the black Asiatic type.

A similar skin has been obtained from Eastern Africa, but in the rest of that continent black leopards seem to be unknown. There is, however, a peculiar

dark phase in South Africa, a specimen of which was obtained in 1885 in hilly land covered with scrub-jungle, near Grahams-town. The ground-colour of this animal was a rich tawny, with an orange tinge; but the spots, instead of being of the usual rosette-like form, were nearly all small and solid, like those on the head of an ordinary leopard; while from the top of the head to near the root of the tail the spots became almost confluent, producing the appearance of a broad streak of black running down the back. A second skin had the black area embracing nearly the whole of the back and flanks, without showing any trace of the spots, while



A BLACK LEOPARD

in those portions of the skin where the latter remained they were of the same form as in the first specimen.

Two other specimens are known; the whole four having been obtained from the Albany district. These dark-coloured South African leopards differ from the black leopards of the northern and eastern parts of Africa and Asia in that while in the latter the rosette-like spots are always retained and clearly visible, in

THE CAT TRIBE: THE LEOPARD

the former the rosettes are lost—as, indeed, is to a considerable extent often the case in ordinary African leopards—and all trace of spots disappears from the blacker portions of the skin. The idea has long been current that black leopards are much fiercer and more bad-tempered than those of the normal colouring.

Far rarer than black leopards are white ones, of which but very few have been met with. The typical

Indian leopard, as already mentioned, has the rosettes large and extending over most of the fore quarters. In the African leopard, on the other hand, the rosettes are everywhere smaller and more crowded, and on the shoulders and head break up into small solid spots, and to this race the name *F. pardus leopardus* has been given.

The Persian leopard (*F. pardus panthera*), on the other hand, is a pale-coloured and rough-haired animal, with an unusually long and bushy tail. Its range extends from the Caucasus and Anatolia, through Persia and Baluchistan, to the north-west districts of India, and perhaps Kashmir. More distinct than all is the Manchurian leopard (*F. pardus villosa*), a large and heavily built animal, with a shaggy coat, marked with very large and widely separated rings, or rosettes, passing into very large solid spots on the shoulders and limbs. In addition to the pigmy Somali race (*F. p. nanopardus*), already referred to, several other local races of African leopards have received distinct names. In ordinary leopards there are no black dots within the light area enclosed by the rosettes, but in some skins from Siam such dots are present, and thus serve to connect the leopard with the jaguar, in which they are normal.

The difference in the size of leopards is so great that while in the smallest the total length of the head, body, and tail does not much exceed 5 feet, in the largest it reaches to at least 8 feet. In a large male, of which the total length was 7 feet 11 inches, the head and body measured 4 feet 9 inches, and the tail 3 feet 2 inches.

The leopard is one of three large cats common to India and Africa; the other two being the lion and the hunting leopard. The distribution of the leopard, however, is more extensive than that of the lion, embracing nearly the whole of Asia, from the Caucasus and Persia to Japan, but not Northern Siberia, including, however, the high plateau of Tibet, where almost all the mammals belong to peculiar species not found elsewhere.

Leopards occur over almost the whole of India, although absent from parts of Sind and the Punjab, and are abundant in Ceylon, Burma, and the islands of the Malay region. Westwards they extend, as we have said, into the Caucasus, Persia, Arabia, Syria, and Palestine, and thence into Africa, where they range from Somaliland and Algeria to Cape Colony. Formerly the range of the species was still greater, the evidence of fossil bones found in the caverns and superficial deposits of Western Europe proving that the leopard—or, at all events, a large cat of which the

bones and teeth are indistinguishable from those of a leopard—inhabited Great Britain, France, Germany, and Spain. The distribution of the leopard is thus wider than that of any other member of the cat family except the lynx.

Next to the tiger in India and the lion in Africa, the leopard is the most formidable carnivore, exclusive in India of bears, to be found in either country. In

its habits it differs essentially from both the lion and the tiger in that it is thoroughly at home in trees, running up a straight-stemmed and smooth-barked trunk with the speed and agility of a monkey. Moreover, the leopard is a much more active animal than the tiger, frequently taking tremendous leaps and springs; and in India, at any rate, although its powers of offence are far inferior, is in some respects a more dangerous animal than the tiger, as it



THE SNOW LEOPARD, OR OUNCE

is roused with less provocation, and is more courageous in attacking those who disturb its repose. The favourite resorts of the Indian leopard are rocky hills covered with scrub, among which it seeks security in caves and under overhanging masses of rock. From strongholds such as these, leopards in Southern and Central India watch the surrounding country towards sunset, and descend with remarkable celerity and stealth, under cover of the rocks, to cut off any straggling animal among the herds or flocks on their return to the village (page 263).

From their habit of lurking in the vicinity of the habitations of man to prey upon cattle, ponies, donkeys, sheep, goats, and dogs, leopards are frequently brought into collision with the natives; and when one is mobbed in a garden, or field of sugar-cane or standing corn, it will charge several times, and bite and claw half a dozen before it is despatched or makes its escape.

At night leopards frequently find their way into goat-folds or calf-pens, climbing over walls or the roofs of native huts in their inroads, and carrying off their prey with great boldness and agility. Leopards have a peculiar liking for the flesh of dogs; there are many villages in parts of Mysore where leopards are numerous in which not a dog is to be found, or only one or two remain, the latter being pointed out by their owners as very lucky animals in that they have escaped their unceasing foe.

This partiality of the leopard for dogs seems, indeed, to be characteristic of the animal from one end of India to the other, and there are many instances where leopards in hill stations have swooped down in broad daylight and carried off pet dogs from before the eyes of their European masters or mistresses.

It is rarely that leopards take to man-eating, but instances do occur, one of which came under my notice many years ago, when a leopard carried off a considerable number of persons from a village in Kashmir. A man-eating leopard was also shot at Mhow in 1908. In Africa the general habits of the leopard appear to be much the same as in India, dogs being from time to time carried off from villages or camps by these marauders.

In addition to dogs, which can, of course, be obtained only in the neighbourhood of villages, leopards prey largely upon the langurs and other monkeys which haunt the rocky hills. Indeed, few animals come amiss in the way of food; about the largest which a leopard is capable of killing being the sambar deer or an Indian bullock.

In killing its prey, the leopard seizes by the throat, and clings with tenacious claws to the animal's neck until it succeeds either in breaking the spine or in strangling the victim, should the bones resist its strength. When the animal is dead, the leopard never attacks the hind quarters first, according to the custom of the tiger, but tears the belly open and drags out all the viscera, making its first meal upon the heart, lungs, liver, etc. It then retreats to some neighbouring hiding-place, and if undisturbed will return to its prey a little after sundown on the following day. In Africa leopards nearly always put the remains of their "kills" in trees, probably for the purpose of protecting them from the attacks of hyenas. On one occasion the skeleton of a lesser kudu antelope was found in the fork of a branch, and it was believed to have been placed there by a leopard.

Leopards do not display that marked partiality for the neighbourhood of water so characteristic of the tiger, many of their haunts in the hills being in districts which are absolutely dry. On occasion, however, they will take to the water as readily and swim as well as a tiger. Although usually found singly or in pairs, leopards, in Africa at least, may sometimes be found in parties comprising several full-grown individuals; probably,

however, these are all members of a single family.

The leopard is a still more silent animal than the tiger, seldom giving vent to any sound, except when disturbed or charging an enemy, when it utters a short roar; its real cry, which is seldom heard, being quite different from the roar of a tiger, and taking the form of a harsh noise, something between a grunt and a cough, repeated three or four times. In India the female gives birth to its young in the spring, during February and March, two, three, or four cubs composing a litter. Young leopards are said to be more difficult to tame than either lions or tigers, and the adults when in captivity always display an uncertain and morose disposition.

R. LYDEKKER

ADVENTURES WITH LEOPARDS

BY MAJOR F. G. ALEXANDER

Of all the beasts in India which I have studied and pursued, the leopard is the one for which I possessed the deepest animosity, as it was instrumental in destroying a dog which, when I was a subaltern, was my companion and friend. In 1877 I was lying on a charpoy, or native bed, outside my tent in the Asseerghur jungles, which was too hot for comfort, and my brown terrier "Scampy" was at my feet. It was a

moonlight night, and my bed was within forty yards of a watercourse. The silent thief and dog-devourer crept up, and my faithful little dog, always alert, jumped from the charpoy and was immediately carried off by the leopard. Next day all I found of my companion's remains was a hind leg over a mile away. From that day I waged war with trap and rifle against the leopard, which is bold to a degree. "Ubique" is the leopard's motto, and you will find the creature in the most unexpected places.

There is probably no animal more dreaded by natives than the man-eating leopard. In January, 1892, I received a report at Moongergaon, Central India, that a man-eating leopard was at large, that it had killed many people, and that the last of its victims lived in a village three miles from my camp. He had been twice attacked, once near the village, but his brother villagers heard his cries and drove off the leopard with axes. A few days afterwards the leopard succeeded in entering the same man's hut through a large drain, and killed him. The villagers living near again heard his cries, and succeeded in beating off the animal, but were too late to save the poor fellow's life. I examined

the drain, and wished to see the wounds the leopard had inflicted, but the deceased had been buried. A few nights later the same leopard carried off a goat from my camp.

A dozen Bheels were lying asleep round a pool close to where the goats had been tethered. They woke up and made a great noise, but failed to rescue the goat. The leopard had the impudence to carry its victim to a spot only three hundred yards distant, and partially devour it. On the following morning I found the remains of

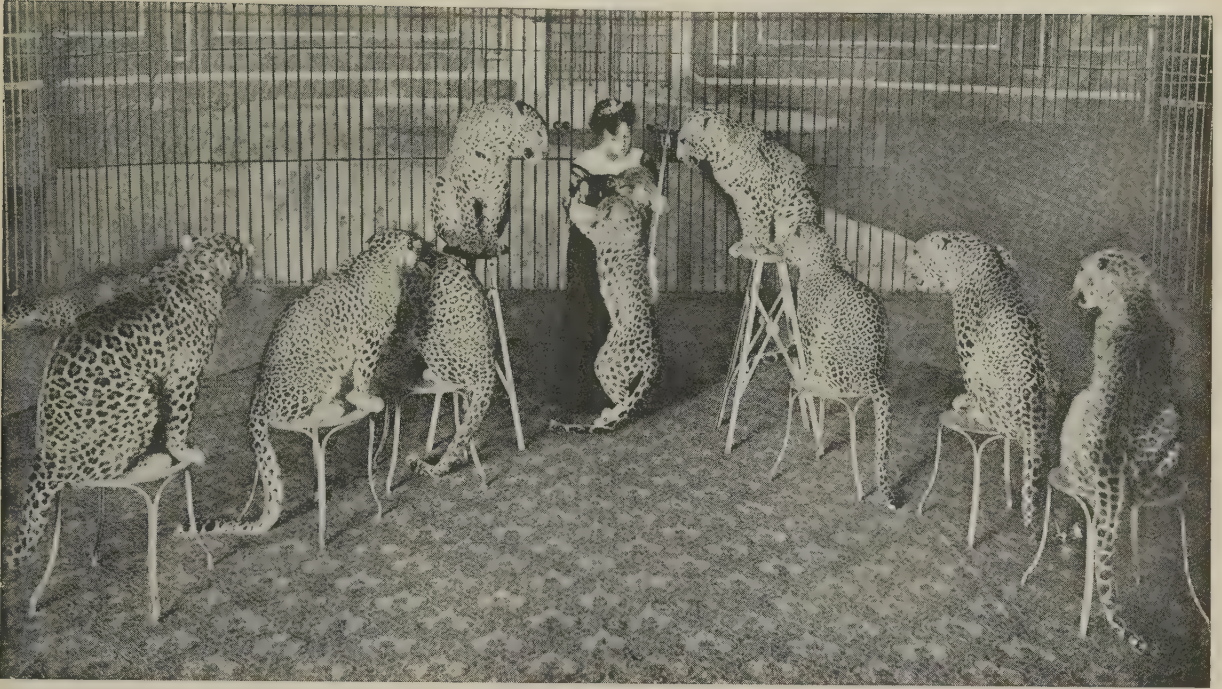


THE JAGUAR

the goat, and placed them where she had originally been tethered. I gave my cook, who was sleeping in a soldier's pal near the Bheels, my breach-loading gun, loaded with slugs, with instructions to fire at the leopard if he approached the kill. At midnight I heard the report of two shots and, leaving my grass hut, I saw the animal in the moonlight slowly moving away, apparently uninjured. On the following day a child gathering sticks near my camp was killed and devoured by the same animal. The next day I was on a conical hill, watching for bear and sambar, and saw the huge beast rolling on the footpath below the hill. I attempted to stalk it, but it saw me, and I had to take a long shot which did not hit the mark.

I had a trap baited with a goat, and sent to the village which the leopard haunted. On the second night a leopard was caught, but it proved to be a very small one, light fawn in colour, and not the golden-hued animal I wished to destroy. Next night I received a message that the man-eater was hard and fast in the trap. I sent my shikari with my rifle to the village at midnight, and he found the beast so powerful that it had broken one of the three-inch teak bars and was on the point of escaping. My shikari shot it. Embedded in its mask were three slugs, fired from my shotgun by the cook. The leopard was a very powerful

ADVENTURES WITH LEOPARDS



A GROUP OF TRAINED LEOPARDS

beast, seven feet in length, with a bull neck, very ruddy skin, and beautifully marked rosettes.

Here is another instance of the boldness and impudence of the leopard. In 1885 Sir E. Bradford, then Governor-General's Agent for Rajputana, invited my wife and me to a picnic. I suppose there were forty Europeans present, besides a staff of cooks, etc., at work behind a boulder. The rendezvous was at the base of a precipitous rock. Most of the guests were interested in what was going on below, but I happened to cast my eyes aloft, and on the top of the rock I saw a leopard's head. Sir E. Bradford possessed two nice white terriers, and they were scampering here and there among the cooks and guests. The late Sir W. Curzon Wyllie was of the company, and I drew his attention to the leopard peering over the rock one hundred and fifty feet above us. I remarked that the leopard was after the terriers, but Sir W. C. Wyllie pooh-poohed the idea that a leopard could have the audacity to descend among such a crowd in search of dog meat. In vain I suggested that the terriers should be tied up, and within ten minutes the animal descended and bolted with one of the dogs.

In Kathiawar the late Captain Francis was one day lunching near a large cactus bush—this was after a beat for a leopard which had been wounded, but its present whereabouts were not exactly known. Whilst the party were refreshing themselves, the leopard, without warning, emerged from the adjacent bush, attacked Francis with tooth and claw, and badly mauled him.

On the other hand, let me cite an instance of extreme fear on the part of a leopard. When at Neemuch I possessed a trap in which I caught a few. One was a very large leopard of the golden-hued type, and it was wheeled to the race-course. Being a powerful beast I thought it necessary to watch the proceedings with a double 12-bore centre-fire rifle. The cage was drawn up near to the Towers of Silence. The animal refused to budge, so I despatched a bullet to wake it up. It then came out and rushed into some racing stables close by. There were three stalls, and it galloped

backwards and forwards, but would not leave the grass structure. The sun was going down, and the stables were fired with a view to forcing the creature into the open. Almost the whole of one side of the stables was open, and yet, when the flames and ashes flew up, the leopard refused to move out, and, rather than face the music, allowed itself to be roasted to death.

The traps generally constructed for leopards are of two sorts—the big mouse-trap with a separate compartment for the living bait, and the huge slab of sheet rock or slate raised by six men and constructed very much on the principle of a brick bird-trap. In the former case the bait end is surrounded with dense thorn bushes to prevent the leopard from clawing the bait. With this trap the animal is caught alive, and the bait, whether dog or goat, passes the night gazing at the leopard, which cannot reach it. In the latter case the bait is offal and fixed under a huge slab, which, when the offal is touched, descends and invariably crushes and kills the leopard.

In using the mouse-trap it is customary to let the leopard have a run for its life. Although there is not much danger in allowing a leopard out, still the unexpected sometimes happens. At Erinpura a leopard, which had been captured in the ordinary trap, was presented to me. I put the trap on the high road about 800 yards from the cantonments, and warned the spectators to go away. About a score of natives, looking on, refused to leave the vicinity. With the usual block-and-pulley arrangement I opened the trap.

The leopard bolted at a great pace, but I shot it too far behind the vulnerable point. In a moment it turned on its haunches and was in the midst of the on-lookers. Among them was a sepoy with a red puggaree, and the leopard singled him out for vengeance. It jumped on the man and fixed him with claw and teeth. The situation was extremely awkward, but so engrossed was the beast with its endeavours to reach the throat of the sepoy that I was able to approach close to it and put the muzzle of my rifle to its body and blow the beast off the man.

HARMSWORTH NATURAL HISTORY

At Salut, about twenty miles from Nowgong, Bundelkhand, I marked down a depredating leopard with three cubs. Three nights in succession I tried to induce the animal to leave its stronghold by tethering a bleating kid near the cave. The leopard and cubs were living under a granite rock with two outlets. Eventually I surrounded the rock with fire, and succeeded in killing the cubs, which were found at the blocked entrances quite dead and blind. For another night the fires were banked up, but in the morning there was no sign of the mother. Despite the terrible ordeal, the creature managed, on the morning of the third day, to force the stone-bound and red-hot entrances and escape. I tracked her for seven miles to a rocky honeycombed hill. Such endurance is rare.

I have tried valerian oil in vain as an attraction to leopards, but have found that tiger cats recognised the odour and appreciated it. As to strange partnerships, I once discovered, in Bundelkhand, a leopard and bear living in amity, and in Central India a porcupine and hyæna. Next to the chita, the leopard is more rapid in attack and can swerve on its axis more quickly than any of the cat tribe.

F. G. ALEXANDER

THE SNOW LEOPARD, OR OUNCE

The snow leopard (*Felis uncia*), or ounce, has been known for over a century, but its habitat was long a mystery. This handsome cat (page 385) is nearly allied to the leopard, from which it differs in the more arched form of the skull, as well as in its paler type of colouring, larger markings, and much longer fur. The long fur is thick and almost of a woolly nature; the ground-colour of the upper parts being a pale whitish grey, occasionally with a faint yellow tinge, passing into pure white beneath. The black spots are much larger than those of the leopard, and over the greater part of the skin form irregular rosettes, with the central area of each generally rather darker than the ground-colour of the fur.

Specimens from the Altai Mountains exhibit a deep tone of colour, tending to bronzy olive, and are thus extremely handsome. As in the leopard, the spots on the head, the lower portions of the limbs, and the extremity of the tail have no light-coloured centres. A black streak extends from near the middle of the back to the root of the tail. The tail itself is remarkable for the length of its fur, scarcely diminishing in diameter from root to tip. The

length of one fine specimen was 7 feet 4 inches, of which 3 feet were occupied by the tail.

The snow leopard inhabits the elevated regions of Central Asia and Ladak, and does not descend below the level of some 9,000 feet above the sea-level in winter, while in summer it ranges to a height of 18,000 feet and upwards; although in the Gilgit district of the North-West Himalaya it is reported to descend as low

as 6,000 feet in winter. The long and thick fur is specially adapted to protect the animal against the severe cold of the regions it inhabits; and the beauty of the fur of a snow leopard killed during winter is almost unrivalled.

The northern range of the snow leopard extends to the Altai and some distance beyond, while to the north-east it embraces Amurland and the island of Saghalien. The animal is probably found all over Tibet, but how far to the west of Gilgit it extends is at present unknown. It has, indeed, been reported from Persia and Armenia, but it has been ascertained that this is owing to the long-haired Persian race of the leopard having been mistaken for the ounce.

Our knowledge of the habits of the snow leopard is very limited, since comparatively few Europeans have seen the animal in its wild state. From living in a practically treeless country, it is probable that it is unable to climb. It preys chiefly upon wild sheep and goats, and marmots and other rodents, while it is also reported to wage war on domesticated sheep and goats when grazing upon the higher grounds, and occasionally to attack ponies. It is said never to molest man. Specimens have from time to time been exhibited in the London Zoological Gardens, and also in Berlin.

THE JAGUAR

The jaguar (*Felis onca*) is the largest representative of the cat family in the New World, being somewhat superior in size to the leopard, with a relatively larger head (page 316). It agrees with the two preceding species in the ornamentation of the fur taking the form



A JAGUAR ON THE BRANCH OF A TREE

of large rosette-like dark spots, enclosing lighter centres, and also in the circular form of the pupil of the eye. The spots, however, are larger than in ordinary leopards, while the ring of each is usually formed of a number of small spots, and the light centre of each rosette contains one or more black spots; the rosettes being arranged in from seven to eight longitudinal rows on each side of the body. The ground

THE CAT TRIBE: THE JAGUAR

colour of the fur is usually of a rich tan, the same tint obtaining in the middle of the rosettes, but there is a considerable amount of individual variation in the general colour, and also in the arrangement of the spots. Examples from the more southerly portions of the animal's range have a more yellow hue, sometimes becoming almost white; while in the region of the Orinoco there is a darker phase, in which the brown fur is marked with scarcely distinguishable black spots, and some individuals are completely black. A phase from Mexico is characterised by the distance at which the small spots that ordinarily constitute the rings are placed from one another, so that entire rings or rosettes of spots only occasionally occur.

The skull of the jaguar may be distinguished at a glance from that of any of the other large cats by the presence of a well-marked tubercle near the middle of the inner side of the socket of the eye, or orbit. The total average length of the jaguar may be set down at about 6 feet 2 inches, of which the tail occupies 2 feet 1 inch, equal to about one-third of the length of the head and body. One large example, however, had a total length of 6 feet 9 inches, of which the tail occupied 2 feet 2 inches; while a still larger specimen is said to have measured upwards of 5 feet from the tip of the nose to the root of the tail. The range of the jaguar embraces the whole of America between the north of Mexico and Texas and the northern parts of Patagonia, its southern limit coinciding approximately with 40° S.

Formerly the jaguar must have inhabited North America, for it is evidently a near relative of the leopard, which made its way into America at the time when there was a connection with Asia across Bering Strait.

At the time the jaguar's ancestor entered the New World, North America was sundered from South America by a communication between the Atlantic and the Pacific; and it was not till a considerably later epoch that the two Americas were connected by land. When this took place, the jaguar—the name is pronounced "hawa" by the Spanish-speaking races—or its ancestor, entered South America and died out in the north.

R. LYDEKKER

A STUDY OF THE JAGUAR

BY W. H. HUDSON

America, the richest continent in bird life, especially in its southern portion, cannot compare with Africa and Asia in the number and size of its larger mammals. Nevertheless, it possesses some which are truly great; and two of its carnivorous beasts, the grisly bear and the timber wolf, are undoubtedly the noblest representatives of their respective families on the globe. It also boasts two grand cats, although inferior in size and courage to those of the Old World: these are the famous jaguar and puma—the tiger and lion of the New World. The former is the man-slayer, and can be described as the king of beasts in America,

albeit, compared with his great cousin of the Old World after which the Spanish colonists named him, he is as the rhea to the ostrich, and as the largest of the American monkeys to the orang-utan and the gorilla.

His entire length is from six and a half feet to seven or eight feet, but in exceptionally large specimens the measurements are greater. The tail is about one-third of the whole length.

If we consider his inches, or look at him in captivity side by side with a full-grown royal tiger of India, we may think the jaguar comparatively a small animal, and perhaps wonder at his reputation. He is not built on the same lines as the tiger; he does not stand so high; the short legs are thicker; the paws larger. He is altogether more massive, and, for his size, no doubt the most powerful beast of prey in existence.

It is necessary to be where the jaguar is, in the conditions which, so to speak, have made him, where he is monarch in the illimitable forest of the tropics, to appreciate his power and understand the perpetual sense of apprehension with which he is regarded by men in the wilderness. He

is not so thoroughly at home throughout his entire range, which extends from Texas and Kansas in the north, through Central and South America, down to the Rio Colorado, which divides the moist, grassy pampas from Patagonia on the Atlantic side of the continent. He is occasionally found in Northern Patagonia, but is only a stray visitor, an intruder there, in an unsuitable district.

The Gauchos, or horsemen of the pampas, when travelling south over the sea-like plains, camping in the open, were accustomed to say that, after crossing the Colorado, they were free of the jaguar. His presence on the treeless pampas, where he is not in perfect harmony with his surroundings, is to be accounted for by the fact that these plains are the favourite habitat of herbaceous mammals on which the jaguar preys. Essentially an animal of the tropics, of a region of great forests and waters exceeding Europe in area, he is, as has been said, a water cat of arboreal habits. Unlike the true, longer-legged tiger, he cannot run any great distance and is like the formidable serpent which shares that region with him, the water boa, or "mother of the waters," in his noiseless, subtle motions and invisibility and habit of dropping upon his quarry from an overhanging branch.

The jaguar is a beautiful creature, the ground-colour of the fur a rich golden-red tan, abundantly marked with black rings, enclosing one or two small spots within. This is the typical colouring, and it varies little in the temperate regions; in the hot region the Indians recognise three strongly marked varieties, which they regard as distinct species—the one described; the smaller jaguar, less aquatic in his habits and marked with spots, not rings; and, thirdly, the black variety. They scout the notion that their terrible "black tiger" is a mere "melanic" variation, like the black leopard of the Old World and the wild black rabbit. They regard it as wholly distinct, and



A JAGUAR LYING DOWN.

affirm that it is larger and much more dangerous than the spotted jaguar; that they recognise it by its cry; that it belongs to the terra firma rather than to the water-side; finally, that black pairs with black, and that the cubs are invariably black.

Nevertheless, naturalists have been obliged to make it specifically one with *Felis onca*, the familiar spotted jaguar, since, when stripped of its hide, it is found to be anatomically as much like that beast as the black is like the spotted leopard and the carrion crow like the hooded crow. As to the difference in habits, this point will never, perhaps, be cleared up, on account of the difficulties in the way of careful observation of the animal in a state of nature.

Dr. Alfred Russel Wallace is one of the few European naturalists who have had the rare good-fortune to look at the animal in his native wilds. In "Travels on the Amazon and Rio Negro," he writes: "As I was walking quietly along, I saw a large jet-black animal come out of the forest about twenty yards before me. As it moved slowly on, and its whole body and long curving tail came into full view in the middle of the road, I saw that it was a fine black jaguar. In the middle of the road he turned his head, and for an instant paused and gazed steadily at me, but having, I supposed, other business to attend to, walked steadily on and disappeared in the thicket. As he advanced, I heard the scampering of small animals and the whizzing flight of ground birds clearing the path from their dread enemy."

This effect of the animal's appearance on all the creatures inhabiting the forest gives one some idea of its power and deadly character among them. For when a man enters these shadowy places, he is often struck by the profound stillness and apparent lifelessness, though they may be teeming with life, mammal and bird and reptile, and by all these he, too, is recognised as an enemy. But he is not feared in the same degree; the creatures he is there to persecute find in his case a sufficient, and indeed their best, protection in sitting or lying still, since they can thus escape his duller senses. But from this enemy, this black terror, they cannot hide themselves in the deepest shade and thickest leafage; he sees them too well and moves too subtly and has too deadly a spring; their only safety lies in flying and scuttling out of his path.

It is not strange that Wallace adds that the encounter gave him great pleasure; that he was too much surprised and occupied with admiration at the full view of this greatest, most powerful, and most dangerous creature on the continent to experience fear.

I am here reminded of my own first impression of the living jaguar, the spotted form, seen in a cage in my youth. The sensation was not one of pure pleasure, notwithstanding the noble form and rich, beautiful colouring; it was mixed with and almost overmastered by the feeling expressed by William Blake—"Did He who made the lamb make thee?" He moved up and down the floor of his cage with a tread noiseless as the flight of an owl, going serpentwise in a sinuous or swaying manner, moving his tail like a serpent, and at each step I took towards him he shrank from

me, flattening his ears and disclosing his white teeth, at the same time emitting a low, hissing sound, while his shining pale yellow eyes partially closed and averted themselves from my sight.

For it is his instinct to remain always hidden from the eye—to see you, himself unseen; to follow you in a deep shade and take you unawares; and it confuses and maddens him to be held in place by bars and gazed openly at. The open gaze affects him like an ice-cold

spray or puff of air, and his impulse is to shrink back and shelter himself from it, even in a place where there is no shadow and no escape. I can see this, or something remaining of it, even in the jaguars that have been confined for years and are stared at every day by numbers of people.

In some way this is true of the cat mind generally, but of the larger cats the jaguar has it in the greatest degree. Unlike most of the other big cats, he never exposes himself to view or takes any risk if it can possibly be avoided. It is invariably said in the natural histories that the jaguar is cowardly; but that is not to describe the instinct properly. It is no more cowardly than the instinct of the guanaco on the plains of Patagonia of seeking the most elevated spot on which to stand motionless, outlined against the sky, the most conspicuous object in the landscape, to keep watch and ward while his fellows are feeding below. The guanaco cannot see, to save himself and his fellows, without being seen; the jaguar cannot exist, since he cannot capture his prey, without making himself invisible; and this being his nature, his most imperative instinct, the open gaze hurts him, as the nocturnal animal's sensitive eye is hurt by a strong light.

Professor St. George Mivart, in his great work on "The Cat," places the carnivora at the head of the mammalia, and in this highest order he ranks the cats first—carnivora, *par excellence*, the very flower and consummation of the mammalian tree. "It may be objected," he says, "that the activities and sense perceptions of certain other beasts are as highly developed as those of the cat tribe. And it is true that only through the possession of perfectly formed bones and muscles, of a delicate sense of hearing and far-reaching vision, antelopes and other creatures are able to escape their carnivorous pursuers; but then they use their 'organisation of escape'; that of the cat tribe may be deemed superior as being not only excellent in itself but fitted to dominate the excellence of other beasts. This does not affirm the inferiority of the human species, man's superiority being mental, and this places him outside and apart from other creatures; but in biological classification, which considers physical development, he takes an inferior place."

Mivart did not go farther and indicate which species in a family so widely distributed and various exhibit the "highest known and most perfectly harmonious expression." I should say that the highest are not the biggest, the tiger and lion, notwithstanding their greater muscular power, but the largest species in which the special powers and aptitudes which characterise the cat have been retained in perfection—the leopard,



THE JAGUAR, AMERICA'S "KING OF BEASTS"

THE CAT TRIBE: THE PUMA

puma, and jaguar, for example; and of these three I should be inclined to give the highest place to the last named. The jaguar is more perfect than tiger and lion, because while developed to a size and power which enable it to overcome the largest and strongest wild beasts inhabiting the entire continent, as well as the largest domestic beasts introduced by man, the cow and the horse, and man himself, it has yet retained in perfection the tree-climbing faculty of the smaller cats.

Consider what this means in a beast of the size and weight of the jaguar, able to kill a man with a blow of its paw, to pull down and kill animals greatly exceeding itself in size, and to drag a carcase into cover which would require three strong men to move; yet capable of ranging freely over long distances and of hunting its arboreal prey in districts where the density of the forest makes it impossible to walk on the ground! As in the case of the small arboreal cats, it ranges and hunts in the trees by means of an endless series of "delicately adjusted springs and graspings." Humboldt, when camped on a river in the Orinoco region, describes how the roar of the jaguars, which surrounded them all night, came from the trees high above the earth. On the ground the forest was impenetrable, but the jaguars appeared to move through it as freely as the monkeys.

In southern South America, particularly on the almost treeless pampas, the jaguar's habits have been somewhat modified; I have there met with more than one instance of a Gaucho on a tired horse being followed for hours at a stretch by a jaguar, the animal showing itself openly from time to time, but though it appeared to know that the horse was distressed, it always kept at a considerable distance when the cover was scanty.

Throughout this region the jaguar is now being extirpated; in the Amazonian region he does not appear to decrease, but he avoids the settlements; "the presence of man annoys him," the natives say, and it is rare for a jaguar to become a "man-eater." In some unsettled places he is extraordinarily abundant.

In the mating season, when they are most vocal, they emit wailing cries and yells like those of the domesticated cat, but very much more powerful. Their "roar," as it is called, is a reiterated deep sound between a cough and a growl. Two young are produced at intervals of about two years.

The jaguar preys on the tapir, deer, great ant-eater, agouti, monkeys, and, in fact, on every native mammal with the exception of his rival, the puma, as well as on birds, turtles, fishes, and even the alligator. To fish he lies along a jutting rock or an overhanging branch and watches the water, and when a fish appears strikes it out with a blow of his paw. It is said that he strikes his tail on the water to attract the fishes, especially the fruit-eating fishes that rush to the spot when a splashing sound as of falling fruit is heard. The striking on the water with the tail may not be a habit or premeditated act; it is more probably a common accident, since all cats move their long tails about when watching and excited.

Turtles are captured, as a rule, when they come out

at night on the sandy margins of the rivers to deposit their eggs. The jaguar takes them, as men do, by turning them over on their backs, when he has them at his mercy; with his powerful jaws he is able to tear off the bony under-plate to get at the flesh. He also digs up and devours their eggs. Deer he captures at the drinking-places where he lies in wait for them, morning and evening. His favourite quarry by the water-side is the carpincho, or "river hog," as it is called, a rodent of aquatic habits, and the largest beast of its family. He also preys on the peccary, the wild pig of America, an exceedingly savage and dangerous brute.

The Indians of Guiana say that certain jaguars attach themselves to herds of peccaries, and follow them in their wanderings in the forest. The jaguar that acquires such a habit is called the "master of the herd." When following, he waits to find a peccary separated from his fellows to fall on and slay him. The victim's cry instantly brings the whole crowd on him, and he escapes by climbing the nearest tree, where he is besieged by the furious little beasts, who run round and round, squealing and gnashing their teeth with rage, until, tired of waiting, they go on their way, whereupon the jaguar drops down and secures his prey.

The jaguar appears to know very well how dangerous this game is, and two instances have been recorded by travellers in which the peccaries succeeded in revenging themselves on him. One is in Barrington Brown's "Canoe and Camp Life in British Guiana," the other in J. P. Bigg-Wither's "Pioneering in South Brazil."

The incident was related to Mr. J. P. Bigg-Wither by an Englishman who had spent a great part of his life in exploring the wilds of Brazil. One night he was camping with a fellow-traveller near the River Ivahay, when they were startled by a great noise and commotion in the forest caused by a herd of peccaries. Going to the spot with their guns in the hope of securing one of the animals, as they were without meat, they found at an open spot a jaguar standing on the top of an ant-hill about five feet high, surrounded by a crowd of fifty or sixty furious peccaries, all trying to get at him.

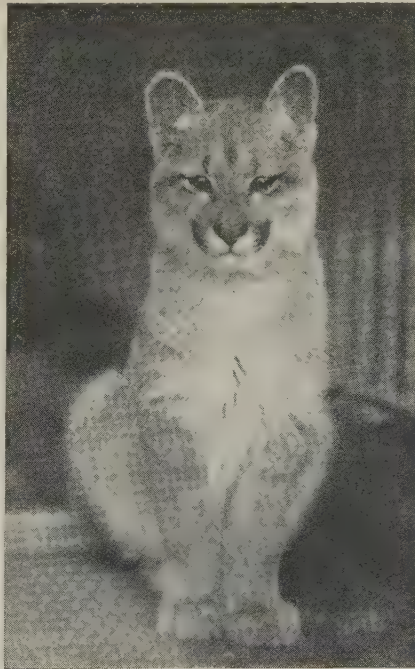
The jaguar was turning round and round, looking for an opening in the crowd to jump down and make his escape; but after a little while he dropped his tail too low, and it was instantly seized by the peccaries, and he was pulled down into the thick of the crowd. Then followed a tremendous scrimmage and frightful noise,

during which the two men thought it prudent to steal off. When they returned, after the herd had gone, they found six dead and dying peccaries on the ground, and some portions of the jaguar's hide, all the rest of him having been devoured.

W. H. HUDSON

THE PUMA

As the jaguar in America usurps the name of the tiger, so in North America the puma (*Felis concolor*) is generally known as the mountain lion, the panther, or, as corrupted, painter, and catamount; in Central and South America it is the "lion." The animal is also known, more especially in works of natural history,



HALF-GROWN PUMA

HARMSWORTH NATURAL HISTORY

as the cougar, which was abbreviated by Buffon from the Brazilian *cuguacu-ara*. Puma, which should be pronounced "pooma," is the native Peruvian name—from the Quichua, the language of the Incas—and is the one usually adopted by English-speaking naturalists. Next to the jaguar, the puma is the largest of the American cats, and is the only large unspotted representative of the genus in the Western hemisphere. In form, it is distinguished by the great relative length of the body and lithe build.

The general colour of this animal's fur is uniform tawny, either redder or greyer, passing into whitish on the under parts of the body; but there is a darker streak running along the middle of the back, and the extremity of the tail is dusky brown. The outer surface of the ears is usually black, with a whitish area near the centre; while the white upper lip is characterised by the presence of a conspicuous black spot in the middle line. In marked contrast with the black nostrils of the other large cats, those of the puma are flesh-coloured. Such is the general colouring, but in North America, at any rate, there is a seasonal variation in the colour of the fur, which assumes in summer a redder, and in winter a greyer tint; while there is considerable local variation in this respect, so that several races are now recognised.

In addition to these local races of the puma, individuals of a brown colour, and others nearly, if not quite, black, are sometimes met with. Other specimens may be nearly white; but the statement that albino pumas have been found in the Alleghany Mountains and New Mexico is not authentic. Somewhat curiously, it does not appear that the length of the coat of the puma varies according to the temperature of the regions it inhabits, so that the animal is in this respect unlike the tiger.

The colour of young cubs is very different from that of the adults, the fur on the body and limbs being marked with large blackish brown quadrangular spots and streaks, while the tail is ringed with the same colour. These spots and rings remain more or less distinct till the cubs are about six months old, when they disappear to a greater or smaller extent, although they can generally be traced till the animal is mature, and may in some instances, especially when the fur is viewed in certain lights, continue throughout life. The presence of these spots in the cubs is important, as showing that the uniform coloration of the adult is an acquired feature, and that the ancestors of the species were doubtless spotted at all ages. It has been suggested that the pattern of these spots and streaks indicates affinity with some of the smaller species of cats.

In those parts of South America where cattle and horses are largely bred the puma is, or was, a terrible scourge. Indeed, so partial is it to horseflesh, that in some parts of Patagonia it was at one time impossible to breed horses owing to the destruction of their colts. An instance is related of a puma springing on a colt among a drove in charge

of a driver, and killing it so suddenly by dislocation of the neck that the animal was actually dead before it fell to the ground. It further appears that in districts where pumas abound the semi-wild horses of South America can scarcely maintain their existence, owing to the slaughter of their young, and this has led to the suggestion that the indigenous horses which inhabited South America in former times may have been totally exterminated by pumas.

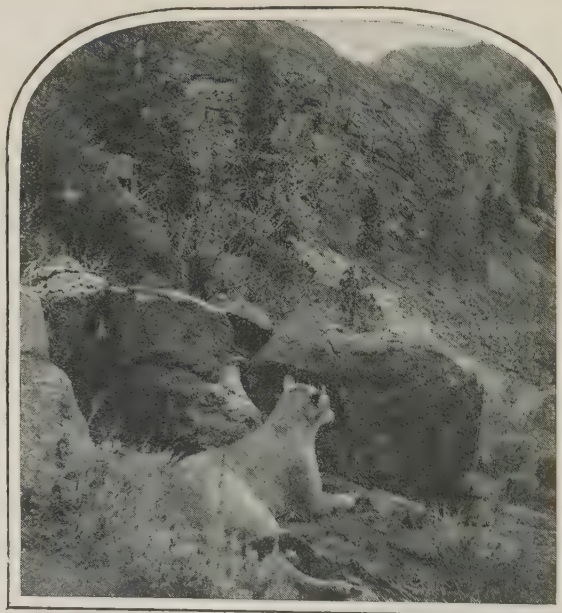
The puma, however, does not confine its ravages on horses to the colts, but will also attack and kill adults. The same is true of cattle, among which calves frequently and cows rarely fall victims to the puma's rapacity. Horned cattle, however, are less preferred than sheep, which, next to horseflesh, form its favourite food in pastoral districts. Indeed, so partial are pumas to mutton, that one has been known to make use of a calf-pen as a place of concealment from which to raid a sheepfold, passing through the former without offering to molest its tenants. It has been alleged that in South America the puma attacks and drives away the jaguar, but the accuracy of the statement has been disputed. Perhaps the same may be the case with regard to the stories of pumas in North America exhibiting an equally marked hostility to the grisly bear.

In regard to its gentleness towards the human race, so well known is this trait to the Gauchos of the pampas that they give it the title of "amigo del cristiano" ("friend of the Christian"); and it is notorious that in places where pumas abound it is perfectly safe for a child to wander alone, and even sleep, on the pampas.

A traveller on foot, who was compelled by stress of circumstances to make his resting-place beneath the shelter of a rock, related that four pumas, the two

parents and their young, appeared during the early part of a moonlight night. "Not feeling the least alarm at their presence, he did not stir; and after a while they began to gambol close to him, concealing themselves from each other among the rocks, just as kittens do, and frequently, while pursuing one another, leaping over him. He continued watching them till past midnight, when they left him." The same traveller also stated that he had once, and once only, killed a puma, adding that nothing would induce him to kill another. On the occasion referred to a puma was found, which sat quite still with its back against a stone, not even moving when he lassoed it. "My informant," writes Mr. W. H. Hudson, "then dismounted and, drawing his knife, advanced to kill it. Still the puma made no attempt to free itself from

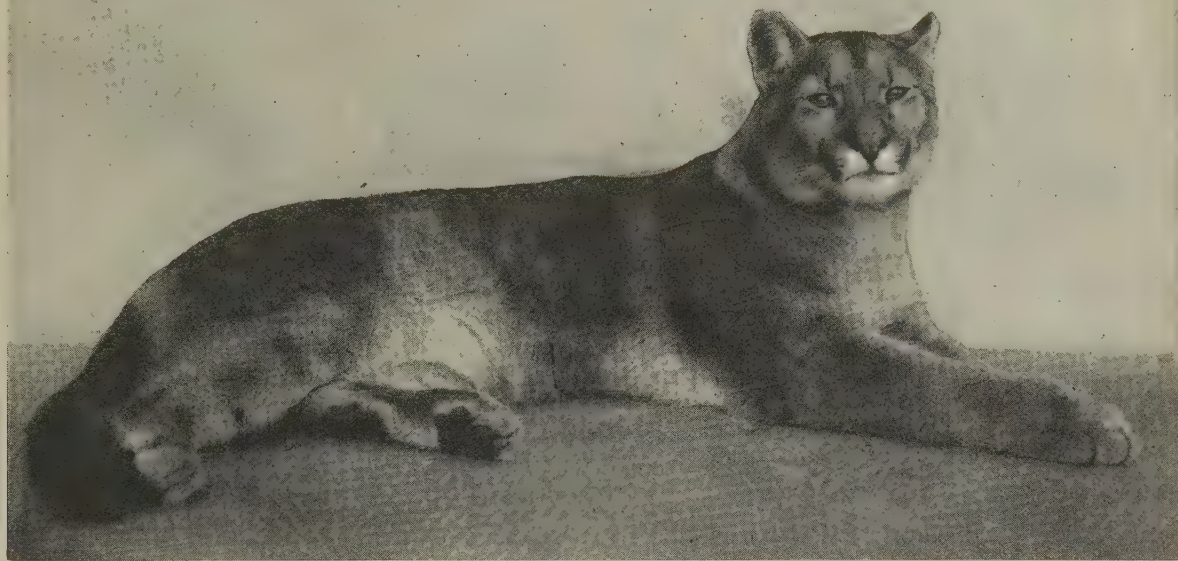
the lasso; but it seemed to know, he said, what was coming, for it began to tremble, the tears ran from its eyes, and it whined in the most pitiful manner. He killed it as it sat there unresisting before him; but after accomplishing the deed, felt that he had committed a murder."



A PUMA, OR COUGAR, IN COLORADO WILDS

Photograph by Keystone View Company

THE CAT TRIBE: THE PUMA



A PUMA IN THE ZOOLOGICAL GARDENS, DUBLIN

When a puma is attacked by dogs, it is roused to the fiercest paroxysms of rage; and with hair erect and eyes flashing like balls of lurid fire, it rushes spitting and snarling on the dogs, utterly regardless of the presence of the hunter. So thoroughly is the hunter ignored on such occasions, he may belabour the puma on the head with a cudgel without drawing attack upon himself; the animal receiving such blows without retaliation, and calmly waiting its opportunity of making a rush upon the dogs. Dogs seem invariably to excite the puma to uncontrollable bursts of passion; and an instance is on record where one of these animals, when taken out of its cage and led by a chain, walked peaceably in front of a crowd of spectators, until, on catching sight of a dog, it suddenly broke away from control, and dashed violently among the people, who scattered in all directions.

In the wilder parts of South America, where domesticated animals are not obtainable, a large proportion of the food of the puma consists of guanaco and deer, but in the northern part of its range deer are the only large animals preyed upon. It must not, however, be considered that the flesh of such animals forms in all cases the chief portion of the puma's diet. Thus, in the dense forests of the Amazon and Orinoco, where several Carnivora tend to assume more or less completely arboreal habits, pumas have been seen to chase monkeys from bough to bough, and from tree to tree; and it would thus seem that the flesh of the latter constitutes a considerable proportion of the food of the puma in those regions.

Strange as it may appear, the pumas of the Adirondacks were wont to prey largely upon the porcupines which are found in abundance in that wilderness, and individuals were frequently killed with their mouths, absolutely bristling with the quills. Whether these animals were selected as an article of food from choice, or whether the pumas were driven to devour them from inability to capture other prey, is uncertain. Be this as it may, porcupines are creatures which, from their sluggish habits and contempt of ordinary foes, may

be easily captured, and would be sure to come in the way of the puma during its nocturnal wanderings. Apparently, indeed, the North American puma will eat almost anything, from deer down to rats, mice, fishes, and even snails.

In the pampas of South America the puma, in addition to the larger animals that have already been mentioned, preys upon large rodents like the aguti and the paca, and likewise upon the coati, while it is also said to kill and eat the noisome skunk. The rhea, or South American ostrich, is also at times hunted by the puma on the pampas, while in New Mexico and Arizona, so severely are the wild turkeys persecuted by it that many hundreds are killed annually, and several of their old breeding-places have become completely deserted. When extremely hard pressed by hunger, the puma is said not to disdain a meal of carrion.

Like most of the larger cats, the puma seeks its prey mainly by night and during the morning and evening twilights, but it hunts occasionally by day. Deer are stalked after the usual stealthy manner of the cat tribe, and when approached within striking distance, are rushed upon in a series of successive leaps, unless, indeed, the puma can spring upon them from an elevation, when a single leap will suffice. If not caught within a few leaps, the deer usually escapes, as its foe then gives up the chase. The leaping powers of the puma are prodigious, and it is said that when pursued by dogs it has been known to spring upwards and reach a bough at a height of twenty feet from the ground, while horizontal leaps of the same distance are by no means uncommon, and an instance is on record where the length of the leap on snow was close upon forty feet. Pumas kill large animals by springing upon their shoulders and dislocating the neck. In the northern portions of their range during the winter they will on occasions pursue deer for long distances when the latter are incapable of rapid flight owing to the depth of snow.

The number of young at a birth varies from one to four or five; but apparently two is the ordinary number, more especially in captivity. The cubs when

first born are from 10 to 12 inches long; they open their eyes at the ninth or tenth day. The age which the puma attains is not ascertained, but one kept at Frankfort for sixteen years died from an accident while in full health and vigour.

Fossil remains of the puma have been found in the superficial deposits of several districts in the United States, probably belonging to the Pleistocene period. Fossil bones of the jaguar occur in the celebrated caverns of Lagoa Santa, in Brazil, in company with those of a number of gigantic extinct mammals, so that both these cats are comparatively old species.

The typical race of the puma inhabits Brazil, and is a large and long-bodied animal, with short legs, the colour of the upper parts varying from yellowish to reddish brown. Some naturalists consider that this race extends northwards into Canada, to the east of the Rocky Mountains, but others recognise several local forms in eastern North America. The puma of western North America (*F. concolor oregonensis*) is also a large animal, of which the general colour is rufous brown. Besides several other local races, the South Patagonian puma (*F. concolor pearsoni*) is distinguished by its light colour and the absence of black on the back of the ears. American naturalists regard these races as distinct species. R. LYDEKKER

MY EXPERIENCES OF THE PUMA

BY W. H. HUDSON

The puma shares with, and is the rival of, the jaguar throughout the whole of the immense territory inhabited by the latter; but it has a vastly greater range, extending east and west from the Atlantic to the Pacific, and north and south from British Columbia to the Strait of Magellan. Whether or not it also inhabits Tierra del Fuego is not known. Every variety of climate and physical condition is comprised within these bounds—from the excessive heat of the tropics to the extreme cold of its northern and southern limits, and on the Pacific side of the continent the wettest and the most rainless regions known.

It includes the Amazonian region of dense forest growth and great rivers, and the sea-like plains of northern and southern South America—the llanos of Venezuela and pampas of Argentina; also the Andean range, where the puma roams to an altitude of 10,000 feet above the sea, and the immense waterless tablelands of Patagonia with its bleak climate.

The bare fact that the puma is at home and in harmony with the conditions in all this extent of territory, in wet and dry, and hot and cold, in mountain and plain and forest and treeless district, shows an adaptiveness and versatility surpassing that of any other carnivore, and, indeed, of any other mammal on the globe. For it must be borne in mind that the species he preys on differ in all of these diverse regions, from the monkeys and other arboreal kinds inhabiting the tropics to the wary and fleet guanaco and rhea of the level Patagonian uplands, and that his strategy must vary according to the

country and the habits, especially the "instincts of escape," of his quarry.

A still more interesting point concerning the puma relates to his disposition; for albeit notorious as the most destructive beast of prey known, both of wild and domestic animals, killing when not in want, but apparently for killing's sake—displaying, too, an extreme animosity towards other large raptorial, such as the jaguar and grisly bear—he is yet perfectly harmless where man is concerned.

This characteristic of the puma, this gentle spirit in so savage a beast, is well known throughout both Americas, but as it has been misinterpreted as due solely to a cowardly spirit, and is also regarded by many naturalists as a moot question, it will be necessary to say more on the subject presently.

The puma varies greatly both in size and colouring. In figure and length he comes nearest to the leopard, but is larger. He is not, as a rule, as big as his great spotted rival, but some exceptionally large individuals have been found to equal the largest jaguar. The average entire length is about 7 feet; 8 feet and more is not an uncommon length. Julius Beerbohm, in "Wanderings in Patagonia," described one he killed, a female of a pale reddish grey colour, which measured 9 feet. Others still larger have been described. In form he differs a good deal from the jaguar; his head is smaller, his body is longer and slimmer, the legs and paws are less massive. Considering its inferiority in size and its less powerful build, the accounts of its destructiveness and power to kill the largest wild and domesticated animals seem almost incredible to those who know of it only by reading. Though



THE PUMA IN ITS NATIVE HAUNTS

inferior to it in strength, it is swifter and more agile than the jaguar.

I am disposed to give the first place among the cat tribe—and the carnivora—to the jaguar, because it is greatest among the cats in muscular power and courage, excepting the lion and tiger, yet has retained in the highest degree of perfection the tree-climbing and other faculties characteristic of the smaller cats.

THE CAT TRIBE: THE PUMA

Nevertheless, when we consider the puma it is difficult to say which of the two should come first: if we accept the view of some naturalists that he is not so adroit a tree-climber and hunter as the other, he comes second to the jaguar as to this point, and in muscular power; but, on the other hand, he possesses greater agility, and is superior in subtlety and in adaptiveness or plasticity. The fact that fewer pumas are met with



THE CLOUDED LEOPARD

in the Amazonian forest region may be due to its greater subtlety—its invisibility. The chief points which strike us about it in districts where it is not uncommon, and where it haunts the outlying settlements to prey on the domestic animals, are its really almost preternatural

cunning coupled with audacity. A good-sized volume might be filled with instances; I will give one only, met with in Patagonia.

During my residence at a cattle-farm on the Rio Negro, a large male puma took to killing the sheep at three establishments in the valley—the one where I was staying and two others a few miles away. On almost every dark night he would visit one of these farms, and, in spite of the dogs and alarms, he usually succeeded in killing several sheep in the folds and in making his escape into the bush. Cattle, horses, and pigs were never assailed by this puma; he was devoted to the sheep.

One night he turned up at the farm next to mine, and was attacked so savagely by the dogs—ten or twelve in number, all large—that he could not get away, and finally took refuge under the verandah. Six or seven men, sleeping in the house, were roused by the commotion and rushed out—armed with swords, knives, and sticks—to assist in killing the robber. Lights were brought, and the puma was found with his back to the wall in a corner of the verandah defending himself against the dogs; but every dog that made a dash to seize him was sent back yelling with pain from a lacerating blow of the puma's paw. The men formed up behind the dogs, and then the master of the

house went to fetch his gun, but before he came back the puma made a sudden dash into the crowd.

Upsetting dogs and men, and bounding away with the pack in close pursuit, he rushed up a big tree about forty yards from the house. "Now we have him safe! Nothing could have been better!" shouted the farmer; but as the puma was invisible in the foliage high up in the tree, it was agreed that they would keep

him there until the morning, when they would be able to see and shoot him. Accordingly, they set to work and made a circle of fires round the tree at a distance of about twelve yards from the trunk, and getting their rugs and tobacco, and kettles to heat water for their maté, they settled comfortably down to spend the long hours until daylight. For two or three months he had carried on his depredation, and, after several hair-breadth escapes, had made a mistake and delivered himself into their hands.

About three o'clock in the morning, when it was still dark, it was very quiet. The dogs, tired of gazing up and barking, were lying at rest by the fires. The talk had died down to silence, and most

of the men were dozing on their rugs, when suddenly a rustling noise was heard in the high branches, and quickly afterwards a thud, as of a heavy body coming to the earth at some distance outside the ring of fires and men and dogs. Up jumped the dogs, and rushed away into the darkness. The puma had made his jump from a height of forty feet at least, and landed beyond the besiegers, and had got clean away. It was thought that he must have injured himself seriously, and that after such an adventure he would return no more; but a few nights later he was again on the scene and continued coming for about a fortnight longer; and then one day, when some of the men were out at a distance in the bush seeking after strayed cattle, they found and succeeded in killing him.

The puma's strategy in hunting is like that of the small cats; he steals upon his quarry until within springing distance, then with one or two to half a dozen tremendous leaps is on it, and, like the jaguar, he almost invariably kills a large animal by dislocating the neck. This is done so quickly, the head being wrenched back with one paw at the moment the puma alights on the back, that those who have witnessed it affirm that the victim is killed as instantaneously as if a bullet had pierced its heart. He preys chiefly on mammals, big and little, from the horse and cow down to the minutest; but, unlike the jaguar, he does not attack or even defend himself against man.

This peculiarity of the puma was well known in South America as long back as the eighteenth century, and was spoken of by the earliest European naturalists—Azara, Molina, and Claudio Gay. But in North America the animal was given a different character. It was assumed that, being a big cat, it was like all other big cats, dangerous to man, and its habit of secretly following a man in the woods was taken as proof that its intention was to spring upon

HARMSWORTH NATURAL HISTORY

and kill and devour him. It was a fine thing for writers of border tales of adventure in a newly settled country, where beasts of prey of large size were few. The romancer's account of the terrible cougar was accepted as true by the naturalists, at all events down to the time of John Bachman and John James Audubon, who were unable to find any authentic instance of a man having been hurt by a puma.

The first true account of the animal in reference to this point appeared in 1892, in my work, "The Naturalist in La Plata"; for it must be noted that even the early Spanish-American naturalists attributed the fact that the puma would not attack "man or child," nor defend itself against a man's attack, to extreme "timidity" or "cowardice." It was a false description of an animal noted for its ferocity towards all other beasts, not only those it preyed on, but the large beasts of prey as well—the jaguar and grisly bear, for example—since the extreme "cowardice" would not have prevented it from springing upon a sleeping man or a child found lost in some lonely spot.

The settlers knew better. They affirmed that it was against the puma's nature to attack a human being, or even a child, or a man thrown from his horse and lying disabled in some desert place; and it thus came about that on the pampas and in Patagonia this animal came to be spoken of as the "friend of man."

Since my book was published, the only addition to the animal's history is contained in Mr. Roosevelt's hunting books, especially his "Outdoor Pastimes of an American Hunter" (1905). After dwelling on the small amount of accurate knowledge we possess concerning it, he writes: "The wildest of all fables about the cougar has been reserved not for hunter or popular writer, but for a professed naturalist. Mr. Hudson's belief in the cougar's peculiar friendship for man and peculiar enmity to other large beasts of prey has not one particle of foundation in fact, as regards, at any rate, the North American form."

Thus does he open a diatribe which need not be quoted; nor need any of the matter contained in the "Naturalist in La Plata" be reproduced here. That work is well known to everyone interested in its subject. The "North American form" of the puma has been well-nigh extirpated by hunters who were not naturalists, which fact sufficiently explains the reason of the small amount of accurate knowledge concerning the animal's habits.

But Mr. Roosevelt is something more than a mere big-game hunter whose chief joy and glory is to assist in the extermination of the noblest mammals on the globe, and the result of his study of the puma is well worth quoting here.

With reference to its power and its enmity to other beasts of prey, he writes: "There is no kind of game, save the full-grown grisly and buffalo, which it

does not at times assail and master. It readily snaps grisly cubs and buffalo calves, and at least one instance I have known of it springing on, slaying, and eating a full-grown wolf." He further says: "The biggest male I ever killed was, in point of size, of muscular power, and of development of teeth and claws, more formidable than the average leopard or jaguar; nor do I believe the ordinary individual of either of those species would have opposed it in fight. It had been killing full-grown steers and horses, yet

it made no effort to charge me, though killed under circumstances which would probably have gained a charge from a big spotted cat." Again he writes: "It never attacks man, and even when hard pressed and wounded, turns to bay with the greatest reluctance, and at the first chance again seeks safety in flight."

Of its extreme cunning and man-following habit, he gives the following account. He discovered the tracks of a puma after it had quitted its hiding-place, and pursued it all day, the time being December, with snow on the ground. But he could not get a glimpse of the beast, and towards

evening trudged wearily home. "When I came out next morning I found that as soon as I had abandoned the chase, my quarry, according to the uncanny habit sometimes displayed by his kind, coolly turned likewise, and deliberately dogged my footsteps to within a mile of the rancho house, his round footprints being as clear as writing in the snow."

Finally, he says that hunters laugh at the tales of dangerous cougars, and adds: "I should have no more hesitation in sleeping out in the wood where there were cougars, or walking through it after nightfall, than I should have if the cougars were tom-cats."

Thus we see that everything Mr. Roosevelt has to relate of the puma's habits goes to prove his own reading of the animal's character wrong—that after ridiculing my case he makes it stronger. According to his view, the puma has acquired its timidity towards man owing to the rifle. At the same time, he says the young puma, left to fend for itself, is liable to mistakes, and attacks animals too big and powerful for it. But he never says that it makes the mistake of attacking man when thus getting experience before it can know anything about the danger of the rifle. The rifle, it may be said in passing, was employed against it in North, but not in South, America. "Indeed, I think," he writes, "they are by nature as ferocious and bloodthirsty as they are cowardly, and that their habit of dogging wayfarers for miles is due to their desire for bloodshed which they lack the courage to realise."

This "uncanny habit" of the animal is differently interpreted by the hunters and herdsmen of the South American plains, and as they have not used the rifle, and have for two or three centuries lived among pumas and seen infinitely more of them than the North American hunters, they probably know them better.



THE MARBLED CAT

THE CAT TRIBE: THE CLOUDED LEOPARD

It has never been said, and is not affirmed here, that the puma never resists and has never injured a man where an unprovoked attack was made on its life. Such cases have been known, and one was related in my work cited above; and I will now give an instance—the only one I have ever met with—of a puma making an unprovoked attack on a man. Oddly enough, the person attacked is a friend of mine, Dr. F. P. Moreno, late Director of the La Plata Museum.

Dr. Moreno relates that one morning, when camping in the vicinity of Lake Viedma, at the foot of the Andes, he went out alone and unarmed for a walk in the scrub, and when some distance away he heard a slight swishing sound behind him, but thinking it was one of his men going out to hunt and urging his horse to a great speed over the sand, he did not turn. A moment after the rushing sound was heard he received a blow which felled him to the ground, and was no sooner down than a puma was on him, clawing about his head and neck. Although much hurt and bleeding, he succeeded in throwing the animal off and struggling to his feet, after which the puma made a few blows at him with its paw, then, turning, bounded away into the bush.

What was the explanation of this extraordinary incident given by Dr. Moreno himself, who had so nearly lost his life, and might very well have been excused for taking a darker view of the animal's dangerous character? It was that on that cold day he had gone out wrapped in a tawny yellow poncho, the exact colour of the guanaco's fur, and that the puma, spying that yellow figure moving among the bushes, mistook him for its usual quarry, and knocked him down and sprang upon him before discovering its mistake.

W. H. HUDSON

THE CLOUDED LEOPARD

The clouded leopard (*Felis nebulosa*), or, as it is often called, the clouded tiger, is a handsomely coloured Old World species, forming the last of the large cats (p. 395). It is a long-bodied, short-legged cat, usually provided with a very long tail, and of thoroughly arboreal habits. The head is more elongated than in any of the species yet noticed; while the pupil of the eye is oval, with its longer diameter vertical. The ground-colour of the fur varies from

greyish to yellowish brown, passing into whitish beneath; the markings on the body taking the form of narrow black stripes, bordering large irregular dark patches or blotches, which may disappear in the adult. On the sides of the face are two distinct black stripes, arising the one from behind the eye, and the other above the angle of the mouth; of which the former extends behind the ears

to join the black markings of the back. The upper parts of the head and the limbs are ornamented with spots; while the tail has a number of dusky rings, which are not infrequently incomplete. The skull is characterised by its low and elongated form, as well as by the great relative strength of the upper tusks, or canine teeth, which are proportionately longer than in any other living species of cat. In size the clouded leopard may be compared to a small individual of an ordinary

leopard. One male measured 5 feet 7½ inches in total length, of which 2 feet 6 inches were taken up by the tail; while another reached 6½ feet, of which 3 feet were occupied by the tail. The length of the tail in these specimens is thus about equal to four-fifths of that of the head and body, but there is a race from the island of Formosa in which the tail is much shorter.

The clouded leopard is confined to the south-eastern parts of Asia, ranging from the Eastern Himalaya, in the districts of Bhutan and Sikkim, to Assam, and thence to Burma, the Malay Peninsula, and the islands of Borneo, Sumatra, and Java. It passes almost the whole of its time in trees, on the branches of which it sleeps, and its food consists chiefly of birds and small mammals. The short-tailed race, found only in Formosa, probably indicates that the distribution of the species on the mainland of Asia was formerly more extensive than at present.

THE MARBLED CAT

The marbled cat (*Felis marmorata*) of the Eastern Himalaya, Assam, Burma, and the Malay region is a smaller species, agreeing in the general character of its markings with the clouded leopard (p. 396). In size it is somewhat larger than a domesticated cat of average dimensions, the length of the head and body varying from 18½ inches to 23 inches, and that of the tail from 14 inches to 15½ inches. The fur is characterised by its thickness and softness; and in Himalayan specimens, at least, has an under-fur of a woolly nature. From the resemblance of its colouring to that of the clouded leopard—in which the marbled fur harmonises with the gnarled and knotted boughs on which the animal reposes—it may be inferred that the marbled cat is an arboreal species.

The Sze-chuen cat (*Felis scripta*), of North-Western China, is another small-sized species allied in colouring to the clouded leopard.

FONTANIER'S CAT

The small marbled cats known as ocelots are generally regarded as an exclusively New World type, being most abundant in Central and South America. The Central Asiatic species known as *Felis tristis*, which

has a long, thick coat with a colour-pattern approximating to that of the clouded leopard, and thus to that of the ocelots, seems to be an Old World representative of the latter group. If this be correct, it will serve to show that the ocelots originally entered America by way of Bering Strait. The clouded leopard and the marbled cat must, on this view, also be regarded as members of the ocelot group, but of a more



THE FISHING CAT

aberrant type. The general colour of Fontanier's cat is smoky grey, with darker bands and blotches. The species is a native of Sze-chuen and Kansu.

THE GOLDEN CAT

The golden or bay cat (*Felis temminckii*) is a well-marked Indo-Malay species, of inferior dimensions to the clouded leopard, and readily distinguished by its deep ferruginous or chestnut colour, which passes into

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bay along the line of the back; the under parts and chin, as well as the lower surface of the tail, being whitish or white. There are dark spots on the chest, while the face has some characteristic but variable markings.

The golden cat is found in the South-Eastern Himalaya, whence it extends into Sze-chuen and Central China; while in the opposite direction its range embraces Burma and a considerable part of the Malay region, although its exact limits are uncertain. Its Chinese representative has been described as a separate species, under the name of *F. dominicanorum*, although it is nothing more than a grey phase of the bay cat.

THE FISHING CAT

The fishing cat (*Felis viverrina*) of India, which is somewhat larger than an ordinary domesticated cat, derives its name from its habit of living to a great extent on fishes, which it captures for itself (p. 397). This species is a short-limbed, spotted cat, with a circular pupil to the eye, a tail about equal in length to one-third the length of the head, and the short and coarse fur lacking the beautiful shiny gloss characteristic of most of the other members of the family.

The head is somewhat elongated, and the ears are short and rounded. The ground-colour of the fur is usually some kind of grey, with a more or less brownish tinge; the back being darker and browner and the under parts whitish. The spots, which may be either dark brown, or of a full black, have no light centres, and are always much longer than broad, although subject to considerable individual variations in shape and size; they cover the whole of the body. The head is marked by a number of longitudinal stripes, starting from the forehead and running to the nape of the neck; these becoming broken up on the shoulders, but reappearing along the back as a line of spots. The greyish white cheeks are generally crossed by two dark streaks; and the limbs are barred and spotted, more especially on their outer sides, although occasionally uniformly coloured. The tail has its upper surface marked with more or less defined dark rings. Altogether, the colouring of the fishing cat recalls that of some varieties of domesticated cats.

A fair-sized male has a total length of about 41½ inches, of which the tail—the hair at its tip being included—takes up about 11½ inches. The height of such an animal at the shoulders will be about 15 inches. The skull may be distinguished from that of any of the species yet mentioned by the fact that in fully adult specimens the socket of the eye is completely surrounded by bone in almost all cases. In this respect the skull resembles that of a monkey and differs from those of most other Carnivora, although a similar feature is displayed in the skulls of some of the other small Indian cats, and also in those of the mungoses. Occasionally, the skull of an adult domesticated cat has the bony ring behind the socket of the eye almost complete.

The geographical range of the fishing cat extends from India to Southern China; but its distribution in the

countries it inhabits is somewhat local. Instead of occurring all over India, this cat is unknown in the peninsula, except on part of the Malabar coast; but it occurs in Ceylon, and is found along the flanks of the Himalaya as far westwards as Nepal. Thence it extends into Burma, the Malay Peninsula, and the South of China, but it appears to be absent from the great Malay Islands, such as Sumatra and Borneo. The species, however, is said to reappear in the island of Formosa; and this, if confirmed, will show that its distribution accords very closely with that of the clouded leopard.

This cat is found in the neighbourhood of thickets bordering lakes, swamps, and rivers, and is stated to be far from uncommon in the vicinity of Calcutta. It does not appear that it has been observed by any European in the act of catching the fish which form such a considerable portion of its diet, and an account of the mode in which the capture is effected would be of much interest. This cat is also said to be a consumer of the large molluscs which are found so abundantly in the swamps of India, and one is known to have eaten a snake. Probably almost any kind of food is equally acceptable to the fishing cat, which doubtless catches all the smaller animals that come within reach.

All writers who have seen it in the wild state bear testimony to its fierce and savage disposition, and it is on record that it has been known to destroy not only sheep, calves, and dogs, but also to carry off infants that have been left unguarded. On one occasion a newly-caught male fishing cat was put into a cage separated by a thin partition from one containing a tame female leopard, which, although young, was about double the size of the fishing cat. The

latter succeeded, however, not only in breaking through the partition between the cages, but actually killed the leopard, although it made no attempt to eat its flesh.

THE LEOPARD-CAT

The pretty little leopard-cat (*Felis bengalensis*), from South-Eastern Asia, is subject to such an extraordinary amount of variation in colour and markings that it has received no fewer than fifteen separate scientific names; such variations have been regarded as indicating distinct species, and several of them, doubtless, represent local races. In size it has been compared to a rather small domesticated cat, with relatively longer legs. The pupil of the eye is circular in ordinary light, and the length of the tail varies from about one-third to rather less than one-half of that of the head and body. Usually the head and body measure together from 24 inches to 26 inches, while the tail has a length of from 11 inches to 12 inches, or rather more.

Although this species comes under the denomination of spotted cats, with the spots much longer than broad, and without light centres, yet the amount of variation is so great that it is almost impossible to give a description that will hold good for all the phases. The ground-colour of the upper parts, however, is very generally some shade of pale tawny, varying from rufous to greyish,



THE LEOPARD-CAT

THE CAT TRIBE: THE SERVAL

while the spots, which have a more or less marked tendency to form longitudinal lines, may be either wholly black, or partly black and partly brown. The spots extend over the under parts and limbs and the upper part of the tail; although the tip of the tail is barred. Four distinct longitudinal stripes on the forehead give a characteristic physiognomy to the head, these stripes being generally continued more or less clearly along the back.

This cat is exclusively a forest-dwelling species, and is found in many parts of India, such as the outer Himalaya as far west as Simla, the greater part of Lower Bengal, the Western Ghats on the Bombay side of the peninsula, and the Wynad and Travancore districts in Madras; but is apparently unknown in Ceylon. Eastwards of the Himalaya its range includes Assam, Burma, the Malay Peninsula, the southern part of China, and the islands of Borneo, Sumatra, and Java, as well as the Philippines.

Of the different phases or races of this cat, it may be observed that while one set of variation is characterised by the tendency to a grey tinge in the ground-colour, others display an equally marked inclination towards a rufous hue, as, indeed, is commonly the case among wild cats.

Although invariably found in forest districts, the leopard-cat is not confined to the hills, as it occurs in the Sundarbans of Bengal at the level of the sea. Its prey consists of small mammals and birds, and it is said to breed in the spring, when it produces from three to four kittens at a birth; the lair being generally in a cave or under an overhanging cliff. In spite of its small size, the leopard-cat is a ferocious and spiteful animal, in captivity lying curled up during the daytime in a dark corner of its cage instead of pacing up and down in the usual restless feline manner.

It is exceedingly difficult to tame, although a specimen living some years ago in the London Zoological Gardens appeared thoroughly tame, and answered readily to the call of its keeper. The depredations of this cat appear to be conducted with great boldness; and it has been seen to carry off a fowl nearly as large as itself, shaking it savagely, and making a successful retreat, in spite of the abuse and the volley of missiles with which the impudent theft was not unnaturally greeted.

THE SERVAL

With the serval (*Felis serval*) we come to an African cat of much larger dimensions than any of the three preceding species (p. 352). It is a spotted cat, easily recognised by the great length of its legs and the comparative shortness of its tail, which is con-

siderably less than half the length of its head and body. The ground-colour of the fur is rich tawny, becoming whitish beneath. The circular black spots are usually large and widely separated, but in the middle line of the back tend to run together in streaks. The cheeks and forehead lack the dark stripes found in so many of the smaller spotted cats, but there are two very characteristic horizontal black bands on the upper part of the inner surface of each fore leg by which a skin of this species may be readily identified. The tail is ringed throughout with black, and has a tip of the same colour. In well-grown adults the total length may reach 4 feet 8 inches, of which 16 inches are occupied by the tail.

This cat is found from one end of Africa to the other, but is more common in the south than in the north. Its "leggy"

build renders the serval by no means a handsome representative of the family. In East Africa the serval inhabits the grassy plains at the foot of Mount Kilimanjaro, where it is not uncommon; and it also ranges to an elevation of five thousand feet or more on the flanks of that mountain.

At that elevation a black specimen has been obtained; and since the natives have a separate name for this black phase, it must be comparatively common. In a black skin from South Africa in the British Museum the spots are distinctly visible when the skin is viewed in certain lights, as, indeed, is corroborated by the fact that a number of such skins have been secured. The small-spotted serval (*F. servalina*) seems to be a distinct species.

AFRICAN TIGER-CAT

Special interest attaches to the African tiger-cat (*Felis celandogaster*), which inhabits the great forest tract of Equatorial Africa, on

account of the remarkable colour-phases it exhibits, and more especially because at least two of these may occur in one and the same individual. The typical phase of this cat is light grey with pale chocolate spots, but another phase is bright red



THE WEST AFRICAN SERVAL



A SERVAL IN AN ATTITUDE OF VIGILANCE



THE OCELOT

(*rubida*), with or without distinct darker spots, while the third and last phase is dark smoky grey, without distinct spotting. In the London Zoological Gardens a specimen of the red phase afterwards developed the dark, smoky coat characteristic of the third phase, thereby exhibiting an instance of colour-change comparable to that of gibbons among the apes. The range of this tiger-cat extends from the West Coast to the Ituri Forest; in size the species is rather larger than an ordinary cat.

THE RUSTY-SPOTTED CAT

It is remarkable that while India is inhabited by the two largest living representatives of the cat family, it also includes the smallest member of the more typical section of the group. The species occupying this position is the pretty little rusty-spotted cat (*Felis rubiginosa*), which is of somewhat smaller dimensions than an average domesticated cat. Its general ground-colour is ruddy grey, passing into white below, while the body and limbs, but not the tail, are spotted.

In some examples the red tinge is greatly developed at the expense of the grey. The individual hairs vary in colour in different portions of their length. The dark spots on the back and side are longer than broad, with a more or less marked tendency to arrange themselves in longitudinal lines, and the species derives both its popular and its scientific name from their general rusty red hue. In the reddish phase, which is characteristic of Ceylon, the spots are, however, brownish black.

As in so many of the smaller Indian cats, the forehead is marked by longitudinal dark stripes, four in number, and there is also a stripe on each side of the face behind the eye. The species is quite peculiar among the spotted cats in having a tail without either spots or rings, its upper surface being of the same tint as the back, while the under side is paler. In length the rusty-spotted cat varies between 16 inches and 18 inches from the tip of the

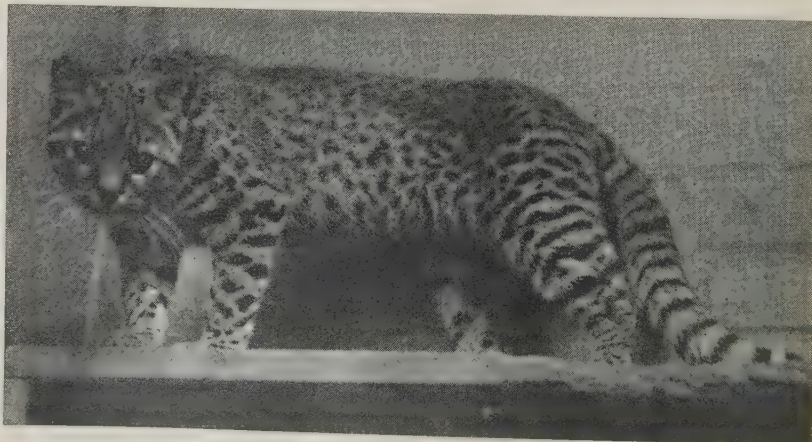
snout to the root of the tail, the length of its tail being constantly $9\frac{1}{2}$ inches. The skull agrees with that of the fishing cat in having the sockets of the eyes completely surrounded by bone, but is peculiar in that there are never more than two premolar teeth in the upper jaw; that is to say, there is only one of these teeth in advance of the flesh tooth.

This cat inhabits Ceylon and Southern India, rarely extending so far northwards as the Central Provinces, and being unknown on the Malabar coast. Its fossil remains have been obtained from a cavern in Madras, thus proving that it was an inhabitant of India at a time when the fauna of that part of the country had a much closer affinity to the fauna of Africa than exists at the present day. Dr. Jerdon observes that it "frequents grass on the dry beds of tanks, brushwood, and occasionally drains in the open country and near villages, and it is said not to be a denizen of the jungles. I had a kitten brought to me very young in 1846, and it became quite tame, and was the admiration of all who saw it. Its activity was marvellous, and it was very playful and elegant in its motions. When it was about eight months old I introduced it into a room where there was a small fawn of the gazelle, and the little creature flew at it the moment it saw it, seized it by the nape, and was with difficulty taken off. I lost it shortly after this. It would occasionally find its way to the rafters of bungalows and hunt for squirrels." The alleged absence of the species from jungles is probably incorrect, for it has been found inhabiting forests in Ceylon.

THE FLAT-HEADED CAT

The flat-headed cat (*Felis planiceps*) is a uniformly coloured species, about the size of a domesticated cat, but with a relatively longer body, shorter legs, and shorter tail; the length of the last being not more than from one-quarter to one-third that of the head and body. The fur is long and soft, and on the upper parts of a dark, rich reddish brown colour, with a curious speckled silvery appearance, due to some of the hairs having white tips. In many specimens a pair of yellow lines diverges from above the nose on to the forehead between the eyes, and the under parts are whitish, more or less splashed with brown. The length of the head and body varies from 21 to 24 inches, while that of the tail is not more than from 6 to 8 inches.

The skull resembles that of the preceding species in having the sockets of the eyes surrounded by bone, but differs in possessing three premolar teeth in the upper jaw, the first of which is relatively larger than in any other living cat. The flat-headed cat has been obtained



GEOFFROY'S TIGER-CAT

THE CAT TRIBE: THE OCELOT

from the Malay Peninsula and the islands of Sumatra and Borneo; but nothing appears to have been ascertained as to its habits in the wild state. Another uniformly coloured cat, with fur of a bright chestnut tint, has been described from Borneo, under the name of the Bornean bay cat (*F. badia*). The tail is relatively longer than in the flat-headed cat.

THE OCELOT

If not equal in beauty of colouring and markings to its much larger cousin the jaguar, the smaller South American cat known as the ocelot (*Felis pardalis*) occupies the next place in this respect (page 400), and exhibits local variations fully as marked as those occurring in the Asiatic leopard-cat. The ocelot is essentially a South American species, ranging northwards, however, into Mexico, and just impinging on

Five distinct forms, regarded by American writers as species, may be recognised. The Rio Grande ocelot (*F. pardalis limitis*), of Mexico and Texas, is a small grey form, with the black markings restricted. The Brazilian race (*F. p. chibigouaza*) is also grey, but of rather larger size, with a tawny tinge on the head and neck. The other three races are larger, and distinctly tawny in ground-colour, with the black markings extended. Of these, the Ecuador race (*F. p. aequatorialis*) is uniformly tawny, tinged with rufous, while in the two remaining forms the colour tends to be greyish posteriorly, the typical South Mexican race being inferior in size to the Central American *F. p. costaricensis*.

The total length of the ocelot may vary from 3 feet 1 inch to 4 feet, and that of the tail from 11 to 15 inches. Ocelots are exclusively forest animals, and are expert climbers, capturing most of their



THE JAGUARONDI

the extreme south-western borders of the United States. Southwards it extends to Paraguay, but is unknown on the pampas of Argentina, from which it may be inferred that its alleged occurrence in Patagonia is, at least, open to doubt.

Speaking generally, it may be said that the ground-colour varies from tawny yellow to reddish grey. It is always marked with black spots, aggregated in chain-like streaks and blotches, forming elongated spots, each with a black border, enclosing an area which is usually darker than is the general ground-colour. The head and limbs bear small spots, and there are two black stripes over each cheek, and one or two transverse black bands within each fore leg. The tail tends to be ringed, and the under surface of the trunk and the inner sides of the limbs are whitish.

prey, which consists of small mammals and birds, in the trees. In disposition they are extremely fierce and savage in the wild state; but young specimens in captivity are playful and fond of climbing, and also fairly tractable, although their docility depends to some extent upon the nature of their food. The resemblance of the colour-pattern of the ocelots to that of the clouded leopard and the allied Asiatic species has already been referred to (page 397).

SOUTH AMERICAN TIGER-CATS

Mexico and South America are the home of numerous races or species of spotted arboreal tiger-cats, of which the distinctive features and distribution are still imperfectly known. The typical tiger-cat (*F. tigrina*) is a small cat ranging from Guiana to Paraguay, and

distinguished by its bright colouring and delicate skull. The Costa Rican and Brazilian representative of the group has been named *F. wiedi* (*macrura*), while the Brazilian form is known as *F. guttata*, the Colombian as *F. pardinoides*, the Chilian and Patagonian as *F. guigna*, the Argentine and East Patagonian as *F. geoffroyi* (p. 400), and the Cordovan and Tasmanian as *F. salinarum*. Frequently the fur is harsh, and of a dull grizzled colour, varied with black spots and rings. The tail is marked with small black spots, often confluent, but not forming rings. There are three transverse black stripes on the cheek. The head and body measure together a little over 24 inches, and the tail is about 11 inches long. In the Costa Rican tiger-cat (*wiedi*) the fur, however, is softer, and the colour bright fulvous, with the spots, which vary much in size, not running together so as to form a chain-like pattern. In some cases the black patches enclose central areas of a paler tint.

THE PAMPAS CAT

The Pampas cat (*Felis pajeros*), also known as the straw cat, or grass cat, is a well-marked South American species, characteristic of the open country of Argentina and Patagonia, and ranging to the extreme southern limits of the latter country. From the nature of its habitat, it may be regarded as a southern and western representative of the manul cat of the steppes of Central Asia.

This species is about the same size as the European wild cat, but of considerably stouter build, with a smaller head and a shorter tail. The fur is long and yellowish grey in ground-colour, marked with brownish or straw-coloured bands, running obliquely from the back across the flanks, the tail and legs being barred with similar bands. From the eyes two dark patches are continued downwards to meet on the throat. As usual, the under parts of the body are whitish. The total length of the animal is about 3 feet 1 inch, of which 12 inches are occupied by the tail. The skull is remarkable for its extreme shortness, and likewise for the presence of only two pairs of premolar teeth in the upper jaw.

This cat, which may be regarded as one of the most distinctive animals of the Argentine Pampas, is not unlike the European wild cat in its robust form and dark colour, but is larger and more powerful, and inexpressibly savage in disposition. In Chile and other parts of western South America, the Pampas cat is replaced by the colocolo (*F. colocolo*), a handsome species, rather larger than an average domesticated cat, in which the general colour is greyish, with streaks and blotches of chestnut, and a dark band running from the eye to the lower jaw.

THE JAGUARONDI

The jaguarondi (*Felis jaguarondi*), inhabiting Brazil, Guiana, Paraguay, and North-Eastern Mexico, but not extending northwards of the Rio Grande, differs from all the American species yet noticed, with the exception of the puma, in its uniform colouring (p. 401); while in form it is characterised by its elongated body, short limbs, and the great length of the tail, which is

nearly as long as the head and body. The general colour is often blackish or brownish grey, but, as in so many variable species, there is a tendency to the special development either of an unusually greyish or an unusually rufous tinge, so that foxy-coloured specimens are common. The total length of this cat is about 4 feet 7 inches, of which 2 feet 1 inch are occupied by the tail. The pupil of the eye is round, and the species is especially characterised by the peculiar manner in which the nose is, so to speak, pinched in from side to side.

THE EYRA

Strangest in form of all the cats is the South American eyra (*Felis eyra*), which from its long body, short legs, low withers, high rump, and extremely long tail, might almost be mistaken for a member of the weasel family, were it not for its relatively short face. In size it is almost equal to a rather small domesticated cat, but with proportionately shorter legs. The fur is soft and of uniform colour, varying in tint from reddish yellow to brilliant chestnut, with the exception of a distinct whitish spot on each side of the upper lip. The pupil is round, and the skull still more elongated and depressed than in the jaguarondi, to which it is evidently closely allied, although its nose is not so much pinched in at the sides as in that species.

The range of the eyra is practically coextensive with that of the jaguarondi; and both species are equally bloodthirsty, playing havoc with the poultry in the districts they frequent. The eyra, however, as might be expected from its weasel-like shape, is the more lithe and the more active.

THE AFRICAN WILD CAT

The African wild cat, or, as it is frequently termed, the Egyptian or the Kafir cat (*Felis ocreata*, or *maniculata*), is a species of more than ordinary interest, since it is generally regarded as the main parent stock from which the domesticated cat of Europe has sprung. The African species is about the size of a large domesticated cat, and generally of a yellowish colour (becoming more or less grey in some specimens), darker on the back, and paler on the under parts. The body is marked with faint pale stripes, which, however, assume on the limbs the form of distinct dark horizontal bands; and the tail, which is relatively long, is also more or less distinctly ringed towards its tip,

which is completely black. The sides of the face are marked by two horizontal streaks. Very generally the soles of the hind feet are black, although in the paler coloured varieties this part is not darker than the back.

The African wild cat has a wide distribution, being found throughout the continent of Africa, from the Cape to Algiers and Egypt, and also extending into South-Western Asia in Syria



THE EYRA

and Arabia. The African wild cat still survives in Sardinia, and in past times it also ranged into other parts of South-Eastern Europe; its fossil remains having been obtained from the caverns of the rock of Gibraltar, in company with those of several extinct species of mammals. At the period when this cat lived in

THE CAT TRIBE: THE EUROPEAN WILD CAT

Gibraltar, Spain was doubtless connected by land with Africa. These cats were held sacred by the ancient Egyptians, and enormous numbers of their dead bodies embalmed and preserved in tombs and pits; the largest repositories being found in the cities of Bubastis and Beni-Hassan. The cats found in the tombs of these localities are regarded by Professor Virchow merely as tamed individuals of the African wild cat, and having no sort of relationship with the domesticated cat, the origin of which, it is considered, is to be sought for in Europe or Asia. On the other hand, Dr. A. Nehring believed that the black sole of the hind foot, common to the African wild cat and the domesticated cat of Europe, is indicative of the descent of the latter from the former, although it is probable that there is also a considerable strain of the blood of the ordinary wild cat in the domesticated breed of Western Europe.

In this connection it is important to notice that in South Africa it has been ascertained that domesticated cats will breed freely with the wild cats of the country. The South African representative of this species, commonly known as the Kafir, or Caffre, cat, constitutes a distinct local race, *F. ocreata caffre*.

That the ancient Egyptians had succeeded in taming thoroughly the cats of which the mummified bodies are found in such numbers at Bubastis and Beni-Hassan is demonstrated by a painting in the British Museum, representing a fowling scene. Commenting upon this picture, Mr. P. H. Gosse observes that it appears to have been the custom for the fowler to enter upon such expeditions accompanied by some of the female members of his family.

"Embarking on board a boat," writes this naturalist, "with a few decoy birds and a trained cat, they proceeded to such parts of the river as were fringed with dense masses of the tall papyrus reed. Water-fowl of various species swarmed in these rushy coverts; and, by the number of nests with eggs and young usually represented, we are doubtless to infer that the possession of this sort of stock was no less desired than that of the birds themselves. The cat, strange as it may appear, was certainly taught to seize upon the birds; in the picture before us she has just caught one in her mouth, while she holds another with her two fore paws, and a third between her hind paws. It is probable also that, the repugnance of this animal to wet her feet having been overcome by training, she was accustomed to fetch such birds as fell into the water."

Although the evidence of the mummified cats, which are indistinguishable from the African wild cat, points strongly to the correctness of Professor Virchow's conclusion that the ordinary tamed cat

of the ancient Egyptians belonged to that species, it is possible that certain variations from the original type may in some instances have been produced by breeding in a domesticated state.

THE EUROPEAN WILD CAT

The wild cat (*Felis catus*) is the only wild representative of the family *Felidae* found within the British

Islands, where it is almost daily becoming scarcer. This species, which is also known as *F. sylvestris*, is closely related to the African wild cat; some of the characters, such as the thickness of the tail, formerly considered distinctive of the two species now being regarded as invalid.

In general colour this species is not unlike many domesticated cats of the striped type, from which it is distinguished not only by its superior size and strength, but also by its stouter head and the shorter and thicker tail, which, instead of tapering,

preserves a nearly uniform thickness to the tip. The ground-colour of the body is yellowish grey; the markings taking the form of a dark streak along the middle of the back, from which descend more or less nearly vertical stripes of the same hue, these stripes becoming nearly horizontal on the limbs, while the tail is ornamented with similar dark rings and terminates in a black tip. The "whiskers" are more voluminous than in domesticated cats; and in the males the soles of all the feet are black. The length of the tail is usually rather less than one-half that of the head and body.

The male is considerably larger than the female, but shows a great amount of variation in its dimensions. The total average length of the male is about 2 feet 9 inches, of which 11 inches are taken up by the tail, but an unusually large specimen killed near Cawdor Castle had a length of 3 feet 9 inches from the nose to the tip of the tail.

The wild cat was formerly distributed over the forest-clad districts of the larger part of Great Britain, but appears never to have been known in Ireland. It is widely distributed, in suitable localities over the Continent, occurring in France rarely, Germany commonly, Switzerland, Poland, Hungary, Southern Russia, Spain, Dalmatia, Greece, and parts of Turkey, but is unknown in Italy, Norway, Sweden, and Northern Russia. The specimens from the more northerly parts of its range are said to be larger, with longer and thicker fur, than those from its southern habitat. Eastwards it has been recorded from the shores of the Caspian; and a large cat with a short tail killed by Sir O. B. St. John in Persia was referred by its captor to this species.

The wild cat has been an inhabitant of Great Britain since the age of the mammoth, its fossil remains having



THE EGYPTIAN WILD CAT

HARMSWORTH NATURAL HISTORY

been obtained, both there and on the Continent, in caverns containing the bones and teeth of the mammoth and other mammals of the Pleistocene age. It has, however, now completely disappeared from England, and only survives in the mountainous districts of Scotland, its extermination from many of its former haunts being probably due not so much to the destruction of the forests as to the increasing use of firearms. In Wales the species has been completely exterminated, apparently since the middle of the nineteenth century, although half-wild domesticated animals are stated in some cases to show characteristics of the wild cat. In Scotland, although its distribution is greatly restricted, the wild cat is not very uncommon in some of the more secluded localities (page 315).

Wild cats are expert climbers, and their favourite resorts are the most inaccessible mountainous woods, where they retreat not only to hollow trees or deep thickets, but to concealed fissures of rocks, in which they seek both safety and repose, and bring forth and rear their young. The female usually produces from four to five kittens in a litter, and instances are on record where these have been brought forth in the deserted or captured nests of some of the larger birds.

The fierceness and savage disposition of the wild cat, or "cat-a-mountain," as it was often called by the older writers, are proverbial, and are displayed even in the kittens, which will hiss and spit vigorously at intruders on their lair. Several cases are related where wild cats have even attacked human beings. The destruction which they inflict on grouse, ptarmigan, rabbits, hares, fawns, and lambs renders them detested alike by gamekeepers and shepherds, and has thus largely contributed to their reduced numbers in those parts of Scotland where the species still survives. From the relative shortness and bushiness of its tail, it was at one time believed that the wild cat had no share in the parentage of domesticated cats, but this opinion has now been modified. There are undoubted instances where crossing has taken place between the two, such interbreeding having been frequently authenticated.

On this point, Sir William Jardine observed that "in the north of Scotland there has been occasional crossing with our native species, and the result of these crosses has been kept in our houses. I have seen many cats closely resembling the wild cat, and one or two that could scarcely be distinguished from it." Commenting on this statement, Mr. E. Blyth remarked that "such cats are never seen in the southern parts of England; still, as compared with any Indian tame cat, the affinity of the ordinary British cat to *F. catus* is manifest, and is due, I suspect, to frequent intermixture at a time when the tame cat was first introduced into Britain, and continued rare, while the wild species was far more abundant than at present."

Mr. G. S. Miller has separated the Scottish wild cat from its Continental representative as a distinct species, under the name of *F. grampia*. From the Continental animal it is said to differ in

its darker colour and the larger and more sharply defined black markings; the general tone of the upper parts being "broccoli brown" in place of smoky grey. The Scottish wild cat, however, is certainly not more than a race of the Continental species, of which the typical form inhabits Sweden.

R. LYDEKKER

STORIES OF THE WILD CAT

No Irish newspaper correspondent will ever be convinced that the wild cat is not included in the fauna of Ireland. In January of 1910 it was reported from mid-Cork that a wild cat had attacked and injured a man in Caheracon Wood. Now, Ireland is as destitute of wild cats as of snakes. It has never possessed any of the family, though doubtless cats from Irish homesteads, preferring feral life to domestic, have become wild. However, the absence of the wild cat from Ireland figured prominently in a once-famous controversy, for this fact was seriously held to demonstrate that Ireland was an older island than Great Britain. That Ireland should lack representatives of animals plentiful in Great Britain was evidence, it was argued, that the land connections between the two islands must have been broken down while England was still connected with the Continent.

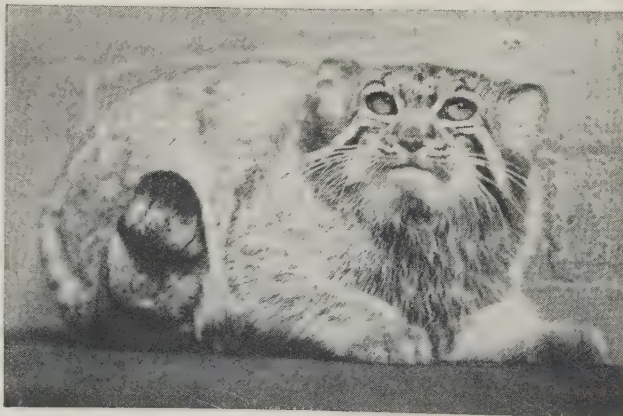
Except the extinct Irish bear, which is supposed to have been akin to the grisly, all the animals which inhabit, or did inhabit, Ireland exist, or have existed, in Scotland. This led Professor Leith Adams to infer that Ireland got her animals by way of a northern land connection. Dr. Scharff, however, holds that, with the exception of the reindeer and the Irish hare, which are northern species, the fauna reached Ireland by a Southern Europe track. Hence the wild cat and some other carnivores unknown to Ireland played a part, though of a purely negative character, in a fascinating problem of distribution. The wild cat being a later comer to Great Britain, this was maintained to be proof positive that it could not extend its travels to the Emerald Isle, because of St. George's Channel and the Irish Sea.

As we have seen, Scotland possesses the wild cat, the absence of which, on sentimental grounds, Ireland is supposed to deplore. Contrary to commonly

accepted opinion, the animal is not so near extinction as has been believed. Laudable regard for the preservation of the remaining British fauna has prompted several Highland landowners to protect this beast. Wild cats in possession are left undisturbed, while some landowners have ordered that, should the animal appear on their property, it is not to be molested.

In the deer forests, where hares and grouse are of no account, the wild cat can do no harm; but wherever fur and feather are regarded

as of importance to an estate, it is "another story"; for the presence of these cats must be viewed with no little distrust, although lending a spice of adventure to sport and pleasure in the Highlands, since they remain invincibly savage.



THE MANUL CAT

Photograph by W. S. Berridge

THE CAT TRIBE: THE MANUL CAT

It is curious to reflect that this, almost the last of British carnivores, should so long have resisted the influence of man, who has succeeded in training the chita and other animals to his service. There exists at Barmbrough an ancient record commemorating the ferocity of the wild cat. The story is that Percival Cresare, a youth of distinguished family, was returning to his home from a fair at Doncaster when, as he was passing through a plantation known as Melton Wood, a wild cat suddenly leapt from the trees and attacked him. The man sought with his gauntleted hands to grapple with his foe, but the latter's sharp teeth and powerful claws were too much for him. Badly mauled, Cresare endeavoured to escape towards Barmbrough; but the cat pursued him, and compelled him to seek shelter in the porch of the church at Barmbrough. Even here the creature did not relinquish the fight, but inflicted such terrible wounds as to cause the death of young Percival, who in his last struggle seems to have crushed the cat with his feet against the wall. In the morning man and cat were found dead in the porch of the church where their weird contest had ended.

Charles St. John, who knew a good deal of the ways of the wild cat, declared that it is easily trapped, though difficult, on account of its strength and agility, to detain in a trap. Inhabiting the most lonely and most inaccessible ranges of rocks and mountains, the wild cat is seldom seen during the day; at night, after the fashion of its domestic relatives, it prowls far and wide, walking with similarly deliberate steps, making the like regular and even track, and hunting its game in an equally tiger-like manner.

Like all other naturalists, St. John emphasises the wild cat's ferocity, and speaking of its strength, notes that its body, when skinned, presents a mass of sinew and cartilage. One experience enabled him to judge at firsthand of its courage and fighting qualities. When grouse shooting, he came suddenly upon a family of wild cats, two full-grown along with three half-grown young ones, but as it was daylight, and there was no probability of their being endangered, they did not attack him.

On another occasion, however, when fishing, he had a different experience. Passing from one pool to another, he had to climb over rocky and broken ground, and in doing so sank up to his knees in some rotten heather and moss, almost landing on a female wild cat. He was as much surprised as was the cat, which suddenly darted from between his feet, her hair on end, and making her look twice her natural size. Three small terriers that accompanied him immediately assailed the cat, which took refuge in a corner of the rocks, where, perched in a recess out of reach of her enemies, she stood spitting and growling furiously.

Having no weapon with him, St. John laid down his fishing-rod, and cut a good-sized stick, and attempted to dislodge her. "As soon as I was six or seven feet from her, she sprang straight at my face over the dogs' heads. Had I not struck her in mid-air as she leaped at me, I should probably have got some severe wound." As it was, the animal, seriously hurt by the blow, fell among the dogs, where she waged the most desperate

fight he had ever witnessed. If the domesticated cat has nine lives, the wild cat, St. John concluded, must have twenty!

E. A. B.

THE MANUL CAT

Apparently nearly allied to the European wild cat is a handsomely coloured species from the Siberian steppes, the Mongolian deserts, and the highlands of Tibet known as the manul cat, or Pallas's cat (*Felis manul*). It is about the size of an ordinary domesticated cat, with very long, thick, and soft fur, and a bushy tail, of about half the length of the head and body (page 404). The head is remarkably broad, and the eyes are directed more forward than in any other species. The general colour of this cat varies from a silvery



A EUROPEAN WILD CAT FEEDING ON A FAWN

grey to a yellowish buff, becoming darker on the back, the chest being dark brown, while the under parts are lighter. The loins are marked by a few widely separated transverse stripes, and the club-like tail has six or seven dark rings. Occasionally also the limbs may be slightly banded, while the front of the head is spotted, and the cheeks are marked by the usual pair of transverse streaks. The peculiar silvery "wash" on the fur is due to the fact that the ends of the longer hairs on the back are white, with short black tips.

In the steppes of Asia this cat takes the place of the wild cat of Europe. In the time of the German naturalist and traveller Pallas (1741-1811), its describer, the range of the manul extended from the southern flanks of the Urals through the Kirghiz, Turki, and Mongolian steppes to South Siberia, and from the foot of the Altai to Lake Baikal; but at the present day it appears to be unknown in the Orenburg steppes. Its food is said to consist largely of the small rodents known as picas, or tailless hares.

THE DESERT CAT

As implied by its name, the Indian desert cat (*Felis ornata*), like the manul cat, is an inhabitant of open regions, and in this respect differs widely from its spotted compatriot, the leopard cat. The desert cat agrees approximately in size with average domesticated cats, but differs from the three preceding species in that the ornamentation of the fur takes the form

of spots, which may have a tendency to arrange themselves in longitudinal lines along the body. The tail is comparatively thin, tapering, and about equal in length to the head and body. The ground-colour of the desert cat is pale sandy, or "isabelline"; the spots on the body are small and rounded, while those on the neck and head are still smaller and elongated, and tend to form lines. The outer surfaces of the limbs have dark bars, and the upper surface of the base of the tail is similarly barred, while near the end the tail is ringed,



PERSIAN CAT AND KITTENS

and its tip is black. The soles of the feet are also black below. This little cat is confined to the desert and sandy regions of Western India, being common in the deserts to the east of the Indus, in Sind, Western Rajputana, and Hurriana, where it subsists largely on the gerbils which abound in such regions. The spotted sandy fur probably harmonises well in colour with the sands, which are dotted here and there with darker pebbles.

In the deserts of Eastern Turkestan, in the neighbourhood of Yarkand and Kashgar, this cat is replaced by the Yarkand desert cat (*F. ornata shawiana*), distinguished by its rather larger sizes and shorter tail.

Nearly related to the desert cat is the so-called waved cat (*F. torquata*) from Northern India, Kashmir, Nepal, etc., generally distinguished by its more uniform colouring of ashy grey, which becomes more or less rufous in some specimens, and passes into buff on the lower parts. The head and back are marked by indistinct longitudinal dark bands, and there are also numerous rows of incomplete vertical stripes, passing into spots on the sides of the body. The under parts are plain-coloured, but the tail and feet are marked as in the desert cat, the under surface of the latter, however, being brown instead of black. The desert and waved cats have a particular interest in relation to the origin of the domesticated cats of India, since the former interbreeds with domesticated cats, many of which, in the regions inhabited by the desert cat, are spotted in a nearly similar manner.

In regard to the waved cat, Dr. Blanford remarks that "it is far from improbable that specimens of the present form are merely descendants of tame cats that have run wild. The converse, however, is equally probable, that this is the aboriginal race from which Indian domesticated cats, and possibly those of other countries, are derived; and the fact that skins from parts of India so distant from each other as Nepal, Rajputana, and Kashmir are precisely similar is in favour of the latter view."

Since this passage was penned, the opinion that the waved cat is not a valid species has become intensified.

DOMESTICATED CATS

In the account of the last few species it has been incidentally mentioned that the domesticated cats of various countries interbreed with, and more or less closely resemble in the colour and pattern of their fur, some of the species of wild cats inhabiting the same districts. It has also been stated that the ancient Egyptians were in the habit of taming and training their indigenous wild cat, which has been regarded as the ancestral stock from which were derived all the domesticated cats of Europe.

The most likely view of the relationship of wild to tame cats is that the Egyptian race of the African wild cat was, to a great extent, the original parent stock of the domesticated breeds of Europe, but that there has probably been, at least in many districts, a large amount of subsequent crossing of the original domesticated breed with the European wild cat. It is, however, possible that most of the domesticated cats of India may have had a totally independent origin from those of Europe, and that the desert cat may have been the original parent stock from which they were derived.

The common occurrence of spotted domesticated cats in India—which are comparatively rare in Europe—is, indeed, highly suggestive of an origin from one or more of the numerous spotted wild species now inhabiting that country, while the prevalence of striped cats in Europe is in favour of their origin from the Egyptian wild cat, with more or less crossing with the European wild cat. The prevalence of spotted domesticated cats in India may be solely due to the effects of crossing with their wild compatriots, but the former seems the most natural view. Without going into the question of the origin of the domesticated cats of other regions, the evidence seems to point to the conclusion that the whole of the breeds



THE SIAMESE CAT

found in Europe and Asia have not been derived from one single parent stock.

In connection with the various breeds of domesticated cats (*Felis domestica*), these are distinguished from one another mainly or entirely by such characters as colour, length of hair, or, more rarely, length of tail, and do not present the marked structural differences distinguishing the various breeds of dogs. This general similarity may be partly accounted for by the fact that all cats are required for much the same purpose, so that there

DOMESTICATED CATS

has been no special inducement for breeders to modify their structure. A more important factor in the case, however, is the greater specialisation of a cat as compared with a dog, as is particularly shown in the shortness of the face, the diminution in the number of the teeth, and the peculiar structure of the cheek teeth, these points rendering it obvious that an animal with a short face and few teeth is not capable of those modifications in the length and proportion of the skull which can be so readily induced in creatures with longer muzzles and a greater number of teeth. But that cats are capable of perpetuating for a longer or shorter period structural modifications is proved by a family of these animals with six toes on each foot, in which the peculiarity was inherited to the tenth generation.

Here it is important to observe that two distinct types of colour pattern are noticeable among European domesticated cats. In the one type the pattern on the fur takes the form of dark barrings, or stripes, which on the head are longitudinal, but on the body mainly run in a transverse direction. These striped cats are evidently the type which has been derived from either the Egyptian or the European wild cat, or from both.

In addition to these striped domesticated cats there occur other cats in which the markings take the form of broad bands arranged in a somewhat spiral manner on the flanks and hind quarters; and it is apparently only to cats with this type of colour pattern that the name of "tabbies" properly belongs (p. 408); the word "tabby" originally meaning the well-known pattern on watered or brocaded silk. This pattern may occur in cats of all colours from grey to sandy, and in Persians as well as in Europeans, although it is by no means certain that it has not been introduced into the former breed by crossing with the latter. These tabby cats appear to breed true, and it has been suggested that they are descended from a stock quite different from that which gave rise to the striped phase of domesticated cats. This view, however, requires further evidence before it can be definitely accepted.

As regards colour, European cats are commonly black, white, sandy, tortoiseshell, dun, grey, or the so-called "blue"; the two last-named colours being rarer than the others. In this respect they follow wild breeds, sandy cats representing the rufous and yellow, and blue cats the grey phase already noticed as characteristic of wild species; while white and black cats respectively represent the albino and melanistic phases, which are, however, much more common among domesticated than among wild cats.

All these different colour varieties will generally breed more or less nearly true if prevented from crossing, but it frequently happens that litters will contain different-coloured kittens. Formerly the ordinary European cats were short and smooth-haired animals, but in modern times there has been a large amount of crossing with the Persian breed, which has resulted in

the production of a number of long-haired cats. The striped cat may have been the most common English variety. Its proper ground-colour is grey, marked with a black stripe down the back. The rare grey cats may be regarded as striped cats which have lost all their stripes, with the exception of two transverse bars on the fore legs.

Black cats are in all respects analogous to black leopards, since, even when pure-bred, young kittens of this colour almost invariably show the stripes of the striped grey cat. Usually black cats have some white hairs, more especially on the throat, and by an ever-increasing mixture of white a perfect transition may exist from black to white cats, the same holding good with regard to the other breeds. In pure-bred



THE PERSIAN, OR ANGORA, CAT

black cats the eyes are of a clear yellow. In white cats, on the other hand, the eyes may be of the ordinary greenish yellow tinge, or of a pure blue, while in some cases one eye may be blue and the other yellow, this feature being particularly admired in white Persian cats. As is now well known, white cats with blue eyes are usually deaf, this deafness being probably attributable to the lack of dark pigment characterising the eyes also extending to the ears; such dark pigment being, in some mysterious way, connected with the sense of hearing.

The pure-bred tortoiseshell cat—a colour-phase which is now much rarer in England than it was formerly—should be of an orange-fawn colour, irregularly blotched with black, without any admixture of white. Such cats are almost invariably females, although there is at least one good instance of the occurrence of a pure "tortoiseshell tom." The proper male of this breed, however, is the sandy cat; this difference in the colouring of the two sexes of this breed being very noteworthy, seeing that the males and females of all species of wild cats, with the single exception of the South American jaguarondi—in which the female is the brighter of the two—are coloured alike. Occasionally female sandy cats are to be met with, while sandy-and-white and tortoiseshell-and-white cats may be of either sex. The so-called "blue," or Carthusian, cat is characterised by its long and silky hair being of a uniform greyish blue colour, while the soles of the feet and the lips are black.

Turning to Asiatic cats, it has already been stated that many of those of India have more or less distinctly

spotted coats like their wild compatriots, such colouring being almost unknown in Europe. The most celebrated of all the Asiatic breeds is the Persian, or Angora, cat, its second title being derived from a town in Asia Minor. These cats are characterised by large size, long silky hair—most developed on the throat and under parts—and thick bushy tail (pp. 406, 407).

The colour is generally uniform, varying from pure white to a yellowish or greyish tint, while the lips and soles of the feet are not uncommonly flesh-coloured. The occurrence of individuals with one blue and one yellow eye in this breed has been already noted, while allusion has likewise been made to the opinion that the Persian cat is descended from the manul cat of the Asiatic steppes, an opinion which has failed to obtain support among naturalists. It has been reported that the breed of these cats in Angora has been greatly reduced in numbers, owing to their skins having been in large demand as furs.

The Siamese cat (p. 406) is a very distinct breed, in which the general colour is fawn, with the face, ears, limbs, and tail dark brown. The eyes are blue, and the forehead has two bare spots. The limbs are relatively short, and the hind quarters high. The kittens are white. It has been suggested that the Siamese cat is descended from the wild bay cat of the Indo-Malay countries; and, although such a pedigree is not generally accepted, the marked distinctness of the Siamese breed seems to indicate that it has an origin separate from that of any of the domesticated cats of Europe and Western Asia.

Siam and Burma are the home of another breed known as the Malay cat, in which the tail is only half the usual length, and often, through deformity in its bones, tightly curled up into a knot. These short-tailed Asiatic cats lead to the mention of the tailless cats of the Isle of Man, in which the tail is either reduced to a mere stump, or almost wanting. Owing, probably, to the introduction of ordinary cats from the mainland, Manx cats are now to be met with having tails of all lengths up to 10 inches. Tailless cats also exist in the Crimea and Japan.

Other domesticated breeds to which allusion may be made here include the Mombasa cat from the eastern coast of Africa, said to be distinguished by its stiff and wiry hair, and the Paraguay cat of South America, which is much smaller than ordinary cats, with a long body covered with close-lying short and scanty hair.

Like many of the smaller wild species, ordinary domesticated cats have the pupil of the eye reduced to a narrow vertical slit when at its smallest dimensions. They also agree with their wild cousins in the extremely small development of the sense of smell, depending chiefly upon sight and the exquisite sense of perception residing in the "whiskers." The effects of domestication, however, have considerably increased the reproductive powers of the cat, the tame breeds having young three or four times during the year, and producing from five or six to eight or nine kittens at a birth.

On account of their invaluable qualities as destroyers of mice and vermin, domesticated cats have been

introduced into almost every country in the world. There is, however, still some degree of uncertainty as to the period when they were first known in Europe, although they were in existence there before the Christian era. The animal used by the ancient Greeks for the purposes for which we employ the cat, and called by them *ailuros*, was long considered to be the same as the modern cat, but Professor Rolleston, of Oxford, brought forward a considerable amount of evidence to show that the *ailuros* of the Greeks was

really a marten, and this view receives some support from the fact that no remains of cats have been discovered among the ashes of Pompeii and Herculaneum. That cats continued to be comparatively scarce and valuable animals during the Middle Ages is proved by the laws made in several countries for their special protection, and the fines imposed on those who injured or killed them.

The terrible pests that domesticated cats which indulge in nocturnal poaching, or have taken to a completely wild life in the woods, become is known to all who have to do with rabbit-warrens or

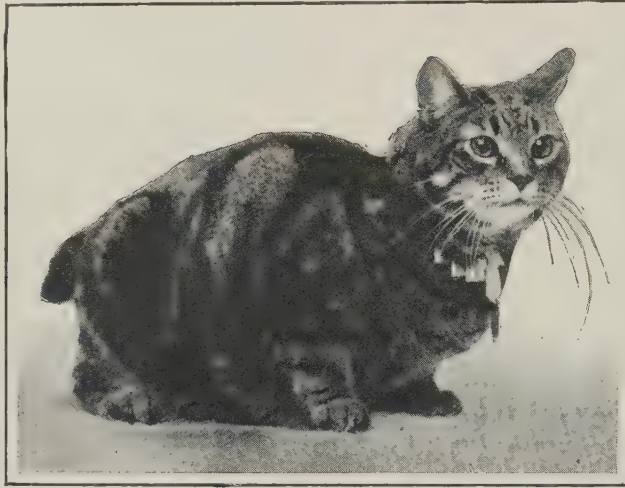
game-preserves. Darwin states that a few cats, which had been originally turned loose in St. Helena, in order to destroy the rats and mice, increased in numbers so as to become a perfect plague. And the same observer mentions that in some parts of South America the domesticated cats which had run wild had become modified into larger creatures of exceeding fierceness, inhabiting rocky hills.

R. LYDEKKER

STORIES OF THE DOMESTICATED CAT

Being essentially the animal of the home, the cat has almost invariably the lady of the house for its patron saint. Most women like cats. If they do not like them, they very much dislike them; there appears to be no room for compromise. But there are men to whom the cat is anathema. One of the most famous of modern generals finds the presence of a cat induces symptoms of acute asthma. He is not the first, nor will he be the last, victim of this antipathy. Another singular case is that of a lady whose dislike of cats is quite as inexplicable. It is not that she finds in the form or habits of the creature anything upon which she could base a logical indictment; the fact is, she has always had an unreasoning, overmastering fear of cats, a dread impossible of definition or explanation, yet so real that to be alone in a house with a cat is to make her seriously ill.

Be that as it may, women are for the most part the best friends of the cat. The number of this animal's admirers is larger than is admitted. Many a young lady cherishes an affection for the cat which she dare not confess, for the reason that the love of an unmarried woman for cats is popularly regarded as clear evidence that she is condemned to perpetual spinsterhood. The women who love cats and avow their affection have done much for the improvement of the domesticated breeds, for the success of the numerous cat shows in England and Scotland is very largely due to the patronage of the ladies, both as exhibitors and visitors.



A "TABBY" CAT

DOMESTICATED CATS

Naturally, then, fancy-cat breeding being the pastime of women, we find "fashions" in cats, as we find fashions in everything else which engages the attention of the fair sex. But there are certain types to the improvement of which they devote quite laudable pains. Perhaps the Siamese cat is the most admired of the rarer favourites, but there are others, and one must not dogmatise. A handsome all-blue example, for instance, hails from Russia and Iceland, while Indian and Abyssinian representatives help to swell the total of the more distinguished breeds in select circles of fancy-catdom. The most popular of all, however, is the long-haired Persian. It is doubtful whether there is in the whole family of carnivorous creatures a more beautiful or more amusing little animal than a Persian kitten in good condition.

There are Persians and Persians, and vainly would one endeavour to convince the votaries of the several cults that one fine Persian can be as good as a fine specimen of a different variety of Persian. There is no question as to which realises most money, this being the pale chinchilla, a green-eyed cat of a pale, dull silver colour, as little marked or shaded as possible. Next in favour are the slaty-blues which we call blue Persians, handsome animals, with amber-coloured eyes. The white Persian with blue eyes has advanced in popularity, and there is always some demand for blacks with yellow eyes, creams, fawns, and orange-coloured Persians.

To most people the point of importance is the temperament of the cat rather than its breed. There is as much comradeship in a black or tabby of dubious degree as in a Siamese from the very palace of King Chulalongkorn. The love of a cat for its home was impressed upon the writer at an early age. After he had been snugly tucked into his cot one night in a house of which his parents had just taken possession, there was a frightful commotion in the chimney, and presently a cat crawled down into the bedroom, gaunt and starved, looking the shadow of a cat's ghost. Rather than quit its old home it had evaded its owners and remained to risk starvation.

Many years later the writer, walking in a garden, was attracted by the faint mews of a cat to a retired spot, where he found a small feline matron solicitously nursing five kittens. Such a family was preposterous, and the mother philosophically bore the removal of two of her progeny. The other three she was permitted to rear.

Though a stranger to the premises, she displayed astonishing friendliness, and used to leap from her hiding-place and advance to her human friend, and even follow him into the house, with that inimitable air of patronage and recognition of service which a cat alone knows how to affect.

This sort of thing went on for a fortnight, when one day the biped guardian discovered that the mother and two of the little ones were missing. Thinking that ill had befallen them, he waited to see what happened.

By-and-by the cat bounded down from the top of the high garden wall. She came straight to her retreat, took the third kitten in her teeth, trotted off, and, with a terrific spring, scaled the wall and disappeared. It seemed her own home was a hundred yards away. She carried her infants in triumph to her mistress. Home, the real home, proved an irresistible attraction, outweighing the friendship which she had struck up with her defender during her term of maternal cares. Though she never returned to the place of her temporary sojourn, her show of gratitude was obviously genuine. As all the world knows, Mr. Kipling has correctly gauged the nature of the domesticated cat in one of his "Just-so Stories."

But Mr. John St. Loe Strachey preceded Kipling in this analysis of feline temperament, and published in the "Spectator" a charming essay discussing the cat as an unconscious humorist. He made out a fair case for the cat as a conscious humorist, though he was haunted by the suspicion that there might be something in the argument of those who credit the cat only with pomposity, insolence, and cynicism. To which category the behaviour of one of Mr. Strachey's own pets belonged, readers may decide for themselves.

The deliberate rudeness of this cat on one occasion, says her owner, would, had she been a man, have justified death at sight. After a devoted admirer had hunted all over a large garden under a blazing July sun, lest puss should lose her dinner, and had at last brought her into the dining-room in his arms, the cat, instead of exhibiting thanks and running to the plate prepared for her, sat bolt upright at the other end of the room, regarding the company with undisguised contempt, her eyes superciliously half shut, and a tiny speck of red tongue protruding between her teeth. If the thing had not been so well done, it would have been simply vulgar. As it was, it amounted to the most exasperating form of genteel brutality imaginable.

The company having been at last stared out of countenance, the cat slowly rose to her feet and, digging her claws into the carpet, stretched herself, and yawned with lazy self-satisfaction. Then she proceeded by the most circuitous route to her plate, evidently intending it to be clearly understood that she held its presence under the sideboard to be in some way or other due to her own skill and forethought, and that she was under obligation to no person for her meal.

Many distinguished men have ranked cats among their friends, and

felt a pleasure in studying their characters. The cat, then, has its place in literature. Chateaubriand loved cats because of their independence, and because, he said, they were not like dogs, which lick the foot that kicks them. Guy de Maupassant was attracted because they were so soft and warm to handle. Baudelaire went deeper. He likened cats to literary men, since both are sensitive to cold, both addicted to sedentary habits, both yearners after silence—a statement which will be challenged by those aware of the ways of a cat at night



THE JUNGLE CAT

HARMSWORTH NATURAL HISTORY

Dumas' cat seems to have been among the most affectionate and most intelligent of its family. According to a writer in "La Revue," this cat, which the great man named "Mysouf," displayed a dog-like fidelity to its master. Every morning, when Dumas left his home in the Rue de L'Ouest, in Paris, the animal followed him as far as the Rue Sainte-Honoré—so far and no farther. Dumas returned promptly at five in the afternoon, and every evening found "Mysouf" waiting for him in the Rue de Vaugirard. The cat, upon seeing its master, hastened towards him and rubbed with joy against the wall, then walked with arched back along the road. When, however, their own street was reached, he jumped up against Dumas' legs with the frisking affection of a dog, and so continued until within a few yards of the house, where it made a dash for the door. When Dumas dined in town and did not return at the wonted hour, it was useless to open the front door and bid "Mysouf" go out. The animal disregarded all attempts to stir it into activity.

Cats appreciate the comfort of the hearthrug, but they share the fear of fire known to all the wild members of the family. This being so, animal trainers who induce cats to leap through hoops of fire in the circus ring achieve a wonderful feat. There is, however, reason to fear that such exploits may be the outcome of great cruelty in private. At one exhibition of this sort the cats were caricatures of their species—thin, half-starved creatures, whose coats suggested that their fur was badly scorched. Their frantic rush to the side of their master to claw him for the strongly scented food concealed about his clothes testified to the hunger from which the poor creatures were suffering.

The cat's dread of fire has frequently proved of advantage in saving life. Some years ago the members of the West Hill Road Fire Brigade, Brighton, presented a medal to a cat which had rendered signal service. It awakened its mistress by loudly scratching at her bedroom door. The lady at first took no notice, but the cat was so insistent that she was compelled at last to get out of bed and open the door. Immediately she did so, the cat, giving her an expressive look, turned and walked straight down to the kitchen.

The lady, following, found the kitchen table and floor in flames, which were extinguished by the brigade. Instinct will not suffice to account for an act like that, since inherited experience is excluded by the facts of the case. The cat's proceedings seem almost to have been based on reason.

A more remarkable case happened at Hoxton in 1903. A young woman was aroused at night by her mother's cat scratching at her head. She pushed the animal away, but it pawed her hand and by its pertinacity obliged her to rise. She found her mother, the cat's mistress, lying dead at the foot of the stairs. The older woman, who had remained downstairs after her daughter, had, on attempting to climb the stairs, fallen and died. The cat in waking the daughter was clearly seeking to attract her attention. A cat arousing its mistress on the outbreak of fire might be impelled by

fear, but a cat which calls the attention of one person to the death of another can have no such motive.

When one sees the swarms of homeless, starving cats which roam the streets of London, one wonders whether an edict might not be issued providing that stray cats should be mercifully put to death as are homeless dogs. But a market was found for many of these wanderers in the civic wilds. A city firm was asked to supply cats for India to exterminate the rats which disseminate plague, the idea being to turn the mousers loose in the affected districts.

The experiment, whatever its outcome, was at any rate interesting, and recalled the strange cargo of the heroic missionary, John Williams, who, having built a ship of his own, set sail for a distant island to bring back—a cargo of cats! Rats were devouring the substance of his own islanders, and only by the aid of the cats, for which he exchanged the produce of his island, were his efforts to exterminate the enemy successful. E. A. B.

THE JUNGLE CAT

The Indian jungle cat is an important member of the family, since it serves to connect the more typical cats so closely with the lynxes as to render it somewhat unnecessary to refer the latter to a distinct genus. The jungle cat (*Felis chaus*) is slightly superior in size to an ordinary domesticated cat, from which it differs in having a circular pupil to the eye (p. 409), thereby agreeing with the lynxes. It also approximates to the latter in having a few long hairs on the tips of the ears, although these are not sufficiently numerous to form distinct tufts. The tail is, moreover, less elongated than in many of the true cats, varying from one-third to two-fifths the length of the head and body. In the presence of three premolar teeth in the upper

jaw, as well as in the form of the lower flesh tooth, the jungle cat, however, agrees with the more typical representatives of the family, as distinct from the lynxes. The colour of the fur of the body varies from sandy or yellowish grey to greyish brown, the back being darker, with a tendency to reddish in some of its local races, or to a dusky tint in others, while the under parts are whitish, with a yellow or red tinge.

The individual hairs, which vary in length according to the locality whence the animals come, are not of uniform colour throughout their length, the upper ends being generally greyish white, with black tips. As a rule, fully adult animals are more or less uniformly coloured, but the limbs may be marked with dusky transverse bars, while, more rarely, rows of

indistinct spots or wavy lines may be detected on the sides of the body. The inner side of the upper part of the fore limb usually has the two broad transverse bars common to so many cats. The cheeks and breast may be either banded or pale, while the tail is ringed, and its tip, like the summits of the ears, black. The soles of the feet are of a dusky brown colour. The total length of the animal varies from 33 to 39 inches, the length of the tail, with the hair, in the smaller form being 11 inches.



THE CARACAL

THE CAT TRIBE: THE CARACAL

Although the jungle cat may be regarded as a characteristic animal of India, where it is found from Cape Comorin to elevations of about eight thousand feet in the Himalaya, and also occurs in Ceylon and Burma, yet it has a wide range to the west, being represented in the Caucasus and the Caspian districts, and common in Persia, whence it extends through Syria to Northern Africa. Black specimens of this cat are occasionally met with in India. The jungle cat, although, from its nocturnal habits, rarely seen, is described by Dr. Jerdon as frequenting "alike jungles and the open country, and is very partial to long grass and reeds, sugar-cane fields, cornfields, etc. It does much damage to game of all kinds—hares, partridges, etc.—and once I shot a pea-fowl at the edge of a sugar-cane field, when one of these cats sprang out, seized the pea-fowl, and, after a short struggle, for the bird was not dead, carried it off before my astonished eyes, and, in spite of my running up, made good his escape with his booty."

The jungle cat is said to be very destructive of poultry at times. I once suddenly came upon one in the outer Himalaya on the edge of a recently cut field of maize, and the creature, after staring in astonishment for a few seconds, quietly made its way into covert.

The jungle cat is very savage, and, even when caught young, generally untamable. It is said to breed twice a year, like the European wild cat, and to produce three or four kittens at a birth, which, when captured, are extremely difficult to rear.

The typical representative of the species is from the Caspian provinces. The Indian race of this species (*F. chaus affinis*) differs in its slighter build, as well as in the bright, foxy red colour of the back of the ears. The Egyptian race (*F. chaus nilotica*), on the other hand, differs from the typical form in its larger size and more grizzled ears. Two other races have been described.

THE CARACAL

The foxy-coloured cat known as the caracal (*Felis caracal*) is a species of larger size than the jungle cat, though smaller than the true lynxes, and agrees with the latter in its long limbs, pencilled ears, and the characters of its teeth; but in its longer tail, absence of a ruff round the throat, and less close and thick fur, resembles the jungle cat (pages 410, 411). The transition from the typical cats to the lynxes is, therefore, complete.

The caracal, in addition to its relatively long limbs, is characterised by its slender build, by the length of the tail being equal to one-third of that of the hind leg and body, and by the long tufts of black hair surmounting the long ears. From the latter feature the animal is known to the Persians by the name of "siyah-gush"; these terms signifying, *siyah* "black," and *gush* "ears." The skull is characterised

by the elevation of the crown and the shortness of the face; while there are only two premolar teeth in the upper jaw, and the flesh tooth of the lower jaw is distinguished by the presence of the rudiment of the heel which is found fully developed in that of the hyenas.

In colour the caracal varies from a uniform bright rufous fawn to a brownish rufous, the under parts being either a paler rufous or white, and frequently marked with obscure rufous spots. The limbs and tail are coloured like the body, although in some examples the tip of the tail may be black. The outer sides of



THE CARACAL

the ears are either partially or completely black, while their interiors are white. The length of the head and body varies from 26 to 30 inches, and that of the tail from 9 to 10 inches; the height of the shoulder ranging from 16 to 18 inches. This species is sometimes known as the Persian, and also as the red lynx, but the latter name is properly applied to a North American species of the true lynxes. Although everywhere a rare animal, the caracal is spread over the greater part of India, with the exception of the province of Bengal, the Malabar coast, and the Eastern Himalaya. It is unknown westwards of the Bay of Bengal, but towards the south-west is found in Mesopotamia, and perhaps the Persian highlands. It is also met with in Arabia, and in Africa is the sole representative of the lynxes.

There appears to be little information with regard to the habits of the caracal in Africa, and only a scant record of its mode of life in India. It probably dwells among grass and bushes, rather than in forests; and its prey consists largely of gazelles, the smaller species of deer, hares, pea-fowl, floricans, cranes, and other birds. So active is the creature that it is asserted to have the power of springing up and capturing birds on the wing at a height of five or six feet above the ground. The caracal is easily tamed, and in some parts of India is trained to capture several of the animals that form its natural prey. At one time it used to be a favourite amusement to let loose a pair

of tame caracals among a flock of pigeons feeding on the ground, when each would strike down as many as ten birds before the flock could escape. The expression "lynx-eyed" is believed to owe its origin to this species. The caracal of Northern Africa is a large-sized race, distinguished as *F. c. berberorum*.

THE LYNX

Few animals have given rise to more discussion among naturalists in regard to the number of species into which they should be divided than the typical lynxes, some authorities regarding all found in North America as representing species quite distinct from the typical Old World lynx, while others are disposed to consider most of them as varieties of a single species. It was also at one time considered that there were two Old World lynxes occurring to the north of the Alps, one the common lynx of Europe, and the other the Tibetan lynx. It has, however, been shown that these two phases pass imperceptibly into each other; and the lynxes of the colder regions of North America are likewise regarded as races of the same species. The Mediterranean lynx, however, is a distinct species, as is also the red lynx of America.

The true lynxes are mainly a northern group, being unknown in Africa, India, and South America. They are very characteristic of North America, where, northwards of the Rio Grande, they are, with the exception of the puma, the sole representatives of the cat family. Their range in the New World extends farther southwards than in the Old World, as it reaches to Southern California and the Rio Grande. The whole of the true lynxes, apart from the question of species and races, agree with the caracal in the form of the skull, the number and structure of the teeth, the black tufts to the ears, and the relatively long legs. They differ, however, in their stouter build, in the ruff of long hair fringing the throat, and the shorter tail, which is less than one-fourth the length of the head and body; and they are further characterised by the softness and thickness of their beautiful fur, which is frequently marked with spots and highly valued.

In the typical lynx (*Felis lynx*) of the Old World the colour of the fur varies from pale sandy grey, or isabella tint, to rufous fawn washed with grey, but some European skins are rusty red (page 264). The under parts are usually pure white, sometimes more or less distinctly spotted. Although there is a great amount of local variation with regard to the presence of spots on the winter coat, in the summer dress the fur of the body is always marked with small black spots. In some instances—perhaps in young animals only—these spots continue during the winter. This, however, appears to occur only among the lynxes of Europe, those of Asia having the winter dress without spots, except on the flanks and limbs, where they may likewise be wanting. The hairs of the fur vary in colour in different parts of their length, and are tipped with black.

The ears are grey on the outsides, with black margins, tips, and tufts. The length of a full-grown lynx is usually about 33 inches, exclusive of the tail, which measures only 7½ inches; but it has been stated that the length of the head and body may be as much as 40 inches.

The lynx now inhabits the northern districts of Sweden, Norway, and Russia; but has been more or less completely exterminated in most of the forest districts of Central Europe, where it was formerly common. A lynx was, however, killed in the Haute Loire, France, in the year 1822, and a second in Würtemberg in 1846. Eastwards the lynx extends throughout the greater part of Asia, north of the Himalaya, ranging through the Altai into Ladak and Tibet, and occurring in the Upper Indus valley as far westwards as Gilgit. In Europe the lynx is a forest-dwelling animal, being an expert climber, and often found in trees. The lynx of Tibet, distinguished as *Felis lynx isabellina*, however, is an inhabitant of a barren country, and dwells in open ground among rocky districts. It is of a paler colour than the European animal, with shorter hair on the soles of its feet. This difference in colouring is due to the character of its surroundings, this point being confirmed in a remarkable manner by the fact that the lynx found in the Gilgit district, where a certain amount of forest occurs, is intermediate in colouring between the European and Tibetan races. The Turkestan lynx resembles the one from Gilgit.

In Europe the lynx used to be found at low elevations; in Gilgit it occurs at elevations of



THE TIBETAN LYNX

about 5,000 feet, while in Tibet it is not found below about fourteen to fifteen thousand feet in summer. The food varies according to habitat. In Europe the lynx preys on birds and mammals varying in size from mice to goats and sheep, and perhaps occasionally larger species. In disposition it is extremely savage, and will often kill more animals than it can devour; in Gilgit a pair of lynxes killed six sheep in a single night. From two to three cubs are produced at a birth, the lair being usually formed among rocks. The cubs are born blind.

When taken young, the lynx can be easily tamed. I saw a full-grown tame Tibetan lynx in Leh during 1874, and another in Calcutta in 1878. Both were very playful, although the former would occasionally be somewhat too free with its claws, and displayed marvellous agility in capturing the half-wild pigeons which abound in Leh. In Ladak, where the lynx is a rare animal seldom seen by Europeans, its chief food consists of the blue hares which occur in many of the higher valleys.

General Kinloch states that in the summer of 1866, when shooting at a high elevation near Hanle, in Spiti, "I suddenly came upon a female lynx with two cubs. I shot the mother, and as the cubs concealed themselves among some rocks, I barricaded them in, and went on with my hunting. On arriving in camp, I sent back men to try to catch the cubs; in this they succeeded, and brought them back to me. They were

THE CAT TRIBE: THE LYNXES

about the size of half-grown cats, and more spiteful, vicious little devils cannot be imagined; they were, however, very handsome, with immense heads and paws. For two or three days they refused all food, but at the end of that time they fed quite ravenously from the hand. They soon became very tame and playful, although always ready to set their backs up if at all teased, or if a dog came near them."

The Canadian race of the typical lynx (*Felis lynx canadensis*) does not usually exceed 30 inches to the root of the tail, with another 5 inches for the tail itself, but it may reach 40 inches in total length. It varies considerably in tone of colour, being in some climates almost white, although usually of a dark grey, tinged with chestnut, with the limbs darker than the body. The back and the upper part of the legs are mottled with darker blotches, and the tips of the hairs are white.

The Canadian lynx extends from Canada at least as far south as the Adirondack Mountains, and is the *loup cervier* of the French Canadians. In the Adirondacks, where it is nowhere common, it preys, according to Dr. Hart Merriam, "upon the northern hare, and such other small mammals as it can catch, and upon the ruffed grouse and spruce partridge. It has also been known to devour pigs, lambs, and young fawns, but the accounts of its attacking full-grown deer are not to be credited. Its haunts are in the deep forests and bush districts, remote from the paths of man; and, consequently, it rarely intrudes upon the barnyard. Its ordinary gait when in a hurry is a long gallop, like that of the hare, and it is said to swim well. The female commonly has two young at a birth, her lair being usually located in a cavern or hollow tree."

The lynx of Alaska (*F. l. mollipilosa*), like the one inhabiting Newfoundland (*F. l. subsolana*), is regarded as distinct by American writers, but neither is anything more than a local race.

THE BAY LYNX

The bay lynx, or red lynx (*Felis rufa*, or *Felis ruffa*), commonly known in America as the wild cat, or bobcat, and termed by French Canadians *chat cervier*, has smaller feet, a longer tail, and shorter and closer fur than the Canadian race of the ordinary lynx. In length it measures about 38 inches; and the colour of the fur is yellowish brown, tinged rusty red, the red tint being much more pronounced in the summer than in the winter dress. Upon this ground-colour are large, solid, dark brown or black spots over the body, narrow dark streaks on the head, and a blackish stripe down the middle of the back; the chin and throat are wholly white, but the white of the rest of the under parts is spotted with black. Such are the characters of the typical race, which inhabits eastern North America.

In Florida the typical race is replaced by one (*F. r. floridana*) in which the colour is darker and the markings are more strongly defined; and in Nova Scotia there is a third race (*F. r. gigas*), distinguished by its larger size, stouter build, and the darker colour of the upper parts. There is also a very fully and hand-

somely spotted race in Texas and Louisiana, known as *F. r. louisianensis*; while yet another race, from Washington and Oregon, in which the markings on the sides of the body tend to run into vertical streaks, has been distinguished as *F. r. fasciata*. This, however, by no means exhausts the list of local races of this species, for among others the lynx inhabiting the high plateau

of Colorado, Utah, and Arizona differs from all the foregoing in being uniformly paler above, and also in its shorter tail and softer fur. The back is suffused with a buff tint, and the blackish marblings found on the face and forehead of the other races are wanting, while the black at the tip of the tail occupies a smaller area than in the latter. There is also some difference with regard to the colouring of the ears, and the hind toes are dark instead of white. This race is known as *F. rufa baileyi*. Besides these external differences, the bay lynx is distin-



THE MEDITERRANEAN LYNX

guished from the ordinary species by certain features in the structure of the skull. In former days bay lynxes abounded all over the wooded districts of North America, but have been banished to thinly inhabited backwood districts. For most of the year they go about either singly or in pairs, in search of hares and other small game; but, in place of following a trail, they kill their victims by pouncing upon them from an ambush.

The bay lynx is mostly seen abroad in early morning and in the evening; it sleeps in hollow trees, in caverns, or on rocky ledges, and in such situations the cubs first see the light. These lynxes are fond of rolling in beds of strong-scented herbs, of which they eat the leaves and flowers.

THE MEDITERRANEAN LYNX

The Mediterranean, or South European, lynx (*Felis pardina*) is, perhaps, the handsomest representative of the entire group, its fur being distinctly spotted at all seasons of the year. The colour of the fur is bright rufous fawn above and white beneath; the body, tail, and limbs have an abundance of blackish spots, while there are longitudinal streaks on the sides of the face, body, and limbs, the tail being barred above. The fringe of long hair on the throat is very strongly developed. This species seems to come nearer to the bay than to the typical lynx, but has a skull differing from those of both. This lynx is found in Spain, Sicily, Sardinia, Greece, and Turkey.

Fossil remains have been found in the caves of Gibraltar with those of the serval; and it thus becomes a curious subject for consideration why the former is now restricted to Europe, and the latter to Africa. Remains referred to the common lynx have been discovered in certain caves of England and the Continent.

THE HUNTING LEOPARD

The hunting leopard (*Cynalurus jubatus*) is the last representative of the cat family, and differs so markedly in certain respects from all the others that it is generally admitted to rank as a distinct genus. It is known to Europeans as the chita (or cheetah); but since this name is equally applicable to the true leopard, its

use is better avoided. The points on which naturalists chiefly rely in making the hunting leopard the representative of a separate genus are twofold. Firstly, and most important, the claws can only be partially withdrawn into their protecting sheaths, so that they always remain to some extent exposed. Secondly, the upper flesh tooth consists simply of a trenchant blade, without the distinct lobe found on its inner side in the true cats and hyænas. While, therefore, the hunting leopard is a more generalised animal than the true cats in regard to its feet, the characters of its upper flesh tooth indicate greater specialisation, this inner lobe occurring in all the more primitive types of carnivora.

Compared with the more typical cats, the hunting leopard is distinguished by the slenderness of its body, and the great relative length of its limbs, which are longer than in any of the true cats, not even excepting the lynxes. In length of body it may be compared with the ordinary leopard, although it stands much higher on the legs. The pupil of the eye is round, the ears are small and rounded, and the fur is rather coarse, and more or less lengthened on the neck and the under parts of the body. The tail is relatively long, being equal to more than half the length of the head and body. The skull is characterised by extreme elevation of the crown, as well as by shortness of its facial portion, in both of which respects it resembles that of the snow leopard. The first of the three upper premolar teeth is unusually small.

In colour the fur of the hunting leopard varies from tawny to bright rufous fawn tint, becoming paler on the under parts. On this ground-colour black spots are distributed over almost the whole of the animal, with the exception of the buff-coloured chin and throat; these spots being round, without any light-coloured centres, and not arranged either in rosettes or in lines. The head is marked by one black stripe running from the front corner of the eye to the upper lip, and sometimes by another from the hinder part of the eye to the ear. The ears are black on the outer surface, but tawny on the margins and at the base. On the tail the spots are confined to the upper surface, but towards the tip they tend to form incomplete rings. Such is the colouring of the adult of this animal.

In the young cubs, however, the fur is very long—especially on the back—and of a uniform grey tint, without any trace of spots; but it is stated that, if a cub in this state be clipped, the under-fur will exhibit distinct spotting. The adult hunting leopard has a total length of about 7 feet, of which $2\frac{1}{2}$ feet are occupied by the tail; the height at the shoulder varies from $2\frac{1}{2}$ to $2\frac{3}{4}$ feet. (See pages 414, 415, 416.)

This animal is one of the few members of the family common to all Africa and India; its range extending from Africa, through Syria, Mesopotamia, and Persia, to the Indian peninsula, where the species is not found

in Bengal, nor on the Malabar coast, nor northwards of the Ganges. It is also said to be unknown in Ceylon; and, like all the cats common to Africa and India, with the exception of the leopard, does not occur to the east of the Bay of Bengal. The hunting leopard of South Africa has been stated to differ from the Indian animal in its stouter build, thicker tail, and denser and more woolly fur, the longest hairs occurring on the neck,



THE HUNTING LEOPARD, OR CHITA

ears, and tail. This woolly hunting leopard was regarded by its describer as a distinct species (*C. lanus*), but it is, at most, only a local race, of which the proper name is *C. jubatus guttatus*.

There appears to be comparatively little information with regard to the distribution of the hunting leopard in Africa. According to native reports, it is very rare in South-East Africa, although found more commonly than elsewhere in the rocky gorges of the Bombo Mountains, where it lies concealed in the dense jungle, from which it occasionally ventures forth to the open plains. Its chief prey consists of various species of antelope. It is regarded as perfectly harmless, and indeed cowardly, towards man. Sportsmen and native hunters often mistake hunting leopards for immature lionesses when seen at a little distance on the sandy plains. To the natives of South-East Africa the animal is known as the n'gulule.

R. LYDEKKER

THE CHITA, WILD AND TAME

BY MAJOR F. G. ALEXANDER

If you look at a tame chita (cheetah) as it stands in front of you, you must be struck by the appearance of its chest and legs. The legs seem to grow out of one hole, and are far nearer together than are those even of the greyhound. As a vessel's bow is made to cut the water, so Nature has devised the fore part of the chita to cleave the air and offer the minimum resistance to it. The very head of the animal is small, and combines to assist its speed. No animal on earth can travel for five hundred yards, or perhaps a little more, so fast as the chita. Its legs are long and made for speed.

I have good reason to know that, in their wild state, they are, when wounded, most dangerous animals,

THE HUNTING LEOPARD

and even when mortally wounded will do their best to reach you; in fact, I would rather face a charging tiger or leopard on foot than the chita.

The majority of naturalists have decided that the chita is a cat, but taking into consideration certain canine teeth which it possesses, certain muscles peculiar to the dog, and the semi-retractile claws, I think it nearer the mark to class it as three-quarters cat and one-quarter dog.

Chitas in their wild state are seldom met with by sportsmen. A hollow tree was once shown to me by my shikari in which two chitas lived. I saw claw marks on the tree. The hollow was nine feet from the ground, and the chitas habitually dropped into it. I climbed the tree, and saw calcined bones at the bottom of the hollow. The tree was but slightly inclined.

Sitting in a pit at night, and watching the remains of a pony which a chita had slain, my shikari, armed with an old Brown Bess loaded with slugs, killed it, and I think the one I killed was its mate. The circumstances were as follows: On the 15th of January, 1892, two Bheels reported that, when collecting sticks within half a mile of my camp, they came suddenly on a leopard, which they found eating a gazelle under a mango tree; the beast simply snarled at them, and continued its meal. Thinking the beast to be a leopard, I proceeded with my rifle and took up my position above the mango tree. I armed my men with a shot-gun loaded with slugs in case of trouble. They managed to drive the beast across my front to an open spot 150 yards from me. I fired and shot the animal through the apex of the heart, and yet, though mortally wounded, it turned on its haunches and rushed uphill towards me at the most terrific pace, and fell dead within ten yards of me. Had the animal not been mortally wounded, I should have been in sore straits, for I had no time to reload. I fired two shots, but only the first took effect. As the chita rushed up the incline it appeared to have no ears—a very significant sign when any of the cat tribe are moving towards you.

I have never yet seen a chita caged when taken out

(Deccan) are neither muzzled nor treated in a way suggesting that they are dangerous to the public.

In 1877, when Sir Salar Jung was Prime Minister to the Nizam of Hyderabad, he lent me three of his best chitas, with a permit to kill six blackbuck in the Nizam's preserves. The beasts were the finest I had ever seen, and probably cost a very large sum of money; all were adult males. They were brought to the preserve on uncovered bullock carts. Each was hooded with a mask similar to a sporting falcon's hood, and by the side of each were two Pathans. The chitas sat dog-like on their haunches on the carts, and were held in leash by one of the attendants. The animals, though hooded, appeared by their cocked ears to be thoroughly alive to approaching sport. One of the Pathans informed me that, before a hunt, the chitas were kept from food for twenty-four hours.

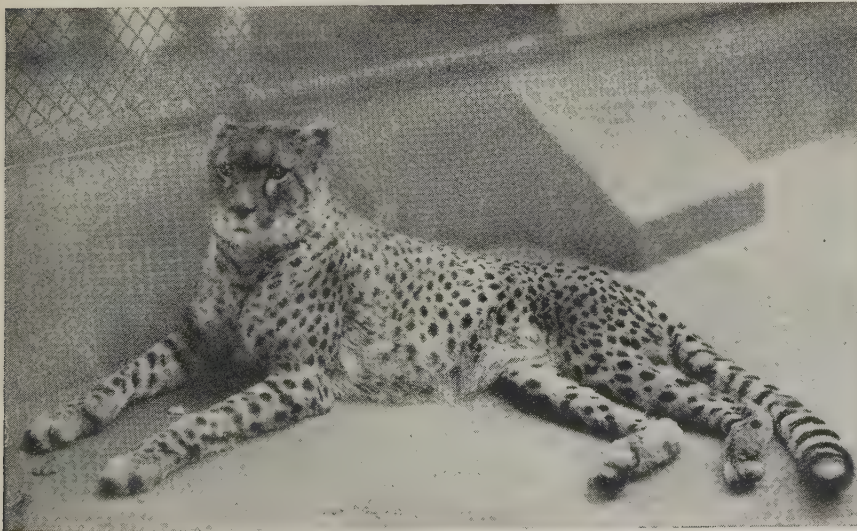
The carts moved through the rumna (grass preserve) parallel to one another, with an interval of two hundred yards between them. The Pathan who first sighted a buck moved forward, and the other carts remained in the rear. As soon as the advanced cart was within 150 yards or so of the buck, the chita's hood was raised, and it was allowed to have a good look at the distant prey. After the survey, the Pathan unleashed it. The chita gracefully dropped to the earth, and, with cat-like movements, began its stalk, and continued to stalk slowly at the trot until the buck began to move; then came a wonderful alteration in tactics. With a low, long gallop, the chita covered an immense amount of ground in each stride, and generally pinned the buck by the throat within 500 yards; if, however, it failed to reach the buck within its coursing distance it abandoned the chase, and waited for cart and attendant.

I have always seen the chita induced to leave hold of the buck in the following way. The second Pathan opened the big vein inside the hind leg of the buck until the wooden ladle overflowed with blood, and handed the ladle to the first attendant (the head one), who offered the blood to the chita, whose teeth were still hard and fast in the buck's throat. The chita

invariably relinquished the throat and began to drink the blood. Whilst doing so, the second attendant drew the carcass away to a safe distance and the first attendant hooded the chita while it was drinking. To open the jugular vein, close to the chita's teeth, in order to draw blood, is a most dangerous operation.

After one chita had had its run, another was given a chance for a buck. In the evening the animals were well fed on buck meat.

A wild boar can cover half a mile in one minute, but for a furlong a chita can travel at double that speed. I have heard that chitas are captured with nets in pits, and other ways, but if they generally inhabit hollow trees their capture is comparatively easy. All the Pathan attendants of



THE HUNTING LEOPARD, OR CHITA

for sport or muzzled for exercise. In the avenues of Jeypore, when taking a morning stroll, I have often met Pathans leading chitas in leash in the same way that greyhounds are taken out for a walk in England. All the hunting chitas I have used were attended by Pathans. The chitas at Jeypore and Hyderabad

chitas at Hyderabad and Jeypore told me that adults only were useful for the chase, and that their training necessitated a good deal of severity, including starvation. I have kept many carnivores in captivity, and though they may be playful and friendly, and recognise you as their master, it is extremely dangerous to

approach them or meddle with them when on the feed. Even a tame otter which will ordinarily roll about and play with you like a cat and allow you to put your hand in its mouth, which contains a double row of teeth, resents any interference when feeding.

F. G. ALEXANDER

EXTINCT CATS

Reference has been made to the occurrence of remains of existing species of the cat family in cavern and other superficial deposits. There is, however, in addition to these, a large number of fossil species of cats which differ more or less markedly from all existing kinds, many of which belong to extinct genera; and no account of the family would be complete without a reference to these extinct types. Some of these, as shown by the greater number of their teeth and other characters, belong to what naturalists call more generalised types, and may have been the ancestral forms from which the living cats have originated; while others are more specialised than even any of the living species.

Referring first to what may be called true extinct cats, or those belonging to the genus *Felis*, it may be mentioned that from strata belonging to the Pliocene, or upper portion of the Tertiary period, in the Siwalik Hills of Northern India, there have been obtained skulls of the great crested cat (*F. cristata*) which must have been fully as large as the tiger. Equally large cats (*F. atrox* and *F. augusta*) have left their remains in the strata of the same geological period in the United States. Numerous cats of this genus, such as *F. arvernensis*, also occur in the Pliocene deposits of France and other countries in Europe, but these are of smaller dimensions, as also are those found in beds belonging to the upper half of the preceding Miocene period, below which true cats are unknown. The Siwalik Hills have also yielded the remains of a member of the family believed to indicate the existence of a species of hunting leopard at the period when those rocks were in process of formation.

Passing on not only to extinct species but likewise to extinct genera, mention may be made first of those remarkable animals known as sabre-toothed tigers (*Machærodus*), although they have no closer affinity with the tiger than with the lion. These sabre-tooths, some of which were equal in size to the lion and tiger, are characterised by the enormous development of the tusks, or canine teeth, of the upper jaw, which formed long sabre-like weapons projecting far below the lower jaw (page 28).

These tusks were so long that if the animal opened its mouth only to the same extent as a modern tiger, they would obviously block the gape and be worse than useless. It has accordingly been suggested that these animals attacked with their jaws closed, stabbing

with the projecting extremities of the upper tusks, but this would apparently tend to injure the lower jaw. Moreover, it is difficult to conceive when this mode of biting could have been adopted, as there must have been a time when the tusks, although too long for use in the ordinary manner, would not have projected beyond the border of the lower jaw.

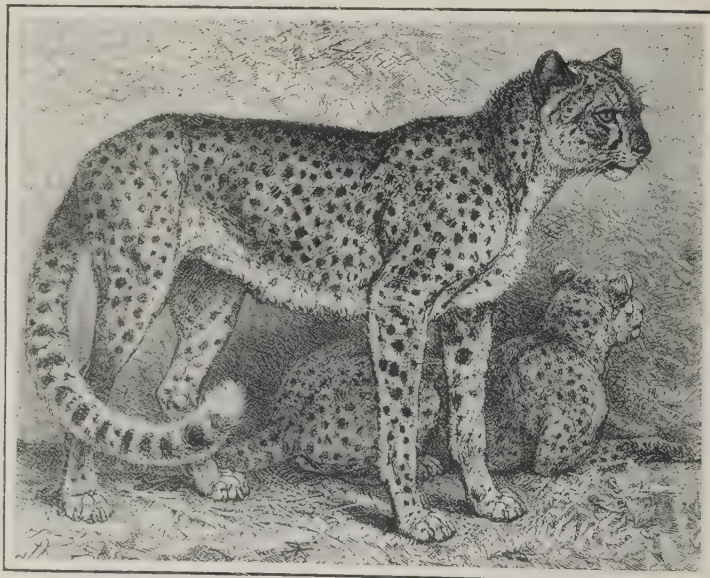
It has long been known that in the mode of articulation of the lower jaw to the skull the sabre-tooths differed from ordinary cats, and this has led an American naturalist to surmise that when attacking they dropped the lower jaw vertically, and thus left the entire length of the upper tusks fully exposed. In such a position, the creature could not bite in the ordinary manner, and it is suggested that the sabre-tooths killed their prey, which probably consisted of short-necked and thick-skinned primitive herbivora, by stabbing or ripping them open in positions where large arteries could easily be reached. It is pointed out that this mode of attack is in harmony with the weakness of the lower jaw in the sabre-tooths and the strength of their fore limbs, which act as fulcra. Although the explanation seems at first sight strange and almost incredible, it appears to suit the peculiar circumstances of the case better than any other yet offered.

These sabre-toothed cats seem to have abounded in the Pleistocene and Pliocene epochs of the earth's history, their remains having been obtained from the cavern and other superficial deposits of England, the Continent, Persia, India, and North and South America. They are also known from strata of much older age, having been found in France in rocks belonging to the upper part of the Oligocene period. The largest species obtained an entry into South America when that country was first united to North America during the early part of the Tertiary.

The earlier representatives of the sabre-tooths, ranging from the Miocene to the Oligocene, were smaller animals, with relatively shorter tusks, such as *Archæolurus*, *Nimravus*, *Dinictis*, and *Hoplophoneus* of North America; *Æluictis*, which is common to France and India; and *Æluropsis*, which is confined to the Miocene Tertiary strata of India.

All the foregoing belong to the same subfamily as the sabre-toothed tigers of the Pliocene and Pleistocene, and have the side of the fore part of each half of the lower jaw developed into a descending flange for the purpose of guarding the upper tusks from injury. They are, therefore, in no

sense ancestral forms of the typical cats. Such a position is, however, held by the genus *Pseudolurus*, from the Miocene of the Continent, in which the jaws are furnished with four pairs of premolar teeth, thus indicating a larger-faced animal than modern cats, and one approximating in these respects to the civet tribe.



A PAIR OF HUNTING LEOPARDS



THE PINE MARTEN

"Creeping from branch to branch in pursuit of birds, squirrels, and other small animals, their sharp and long claws afford them a firm hold, while the long and bushy tail aids them in maintaining their balance on the boughs."



THE COMMON SEAL

"The common seal prefers sheltered sounds and bays, with shallow water and an abundant supply of fish, to more exposed positions, and leaves the water at every tide to rest on the rocks or beach."



CALIFORNIAN SEA LIONS

"The Californian sea lion is the species most commonly seen in captivity in Europe, as it appears to thrive better than any other of the eared seals."



PAUL'S SQUIRREL

"Paul's squirrel was first described by Dr. Matschie in 1894 on the evidence of a living specimen brought to Berlin from Tanga, in German East Africa, by Count St. Paul Hilaire."

THE CIVET TRIBE

THE civets and their relatives, the mungoses, represent the first of a group of three families of Carnivora which exhibit the nearest affinity to the cats. The first of these families embraces a large number of species; the second contains only a single species, the African aard-wolf; while the third is formed by the hyænas, of which there are three species now living. The whole assemblage is strictly confined to the Old World—both at the present day, and mainly also in earlier epochs of the earth's history; and all of the species are inhabitants of the warmer regions of that hemisphere, none of them ranging into the strictly northern countries.

These animals agree with the cats, and differ from all other Carnivora in certain characters connected with the skull, and also in regard to the anatomy of their soft parts. The most obvious feature in connection with the skull is to be found on the under surface in the region of the internal portion of the ear. Here the so-called auditory bulla, lying immediately behind the cavity for the articulation of the lower jaw, is always inflated into a bladder-like form; the internal cavity of this bladder-like chamber, which forms a portion of the structures connected with the organ of hearing, being, except in the hyænas, divided into two compartments by a vertical partition of bone, thus resembling the corresponding portion of the skull in the cat tribe.

In the civet tribe (*Viverridæ*) are included not only the true civets, or civet cats, but a number of more or less closely allied Carnivora, such as genets, ichneumons or mungoses, palm civets, linsangs, etc. This assemblage includes a much more diversified group than the one represented by the cat family, and is therefore much less easy of definition; the difficulty being considerably increased by one very aberrant species from Madagascar, the foussa, which connects the more typical members of the family very closely with the cats. All these animals, however, have longer and less smug faces than cats; their bodies are also longer and their legs shorter than in the members of that family, not even excepting the peculiar eyra.

They have a larger number of cheek teeth than any of the existing cats, the premolar teeth being never less than three—and very frequently four—on each side of both the upper and lower jaws. Moreover, with the exception of the above-mentioned species from Madagascar, which is at once distinguished from all the cats by the presence of four premolar teeth, the members of the civet tribe always have two molar teeth in the lower jaw—that is to say, there is a tooth behind the lower flesh tooth; and in nearly all cases there are also two molar teeth in the upper jaw behind the flesh tooth, these teeth being generally of large

size, and thus very different from the single small upper molar of the cats. With the above-mentioned exception, the upper flesh tooth has only two lobes to its cutting blade, instead of the three found in the cat tribe; while the lower flesh tooth has a large tubercular heel behind the cutting blade.

As a general rule, the feet are furnished with four toes; but in some cases the first toe (thumb) may be wanting in the fore feet, in others the corresponding toe may be absent in the hind feet, while in others, again, both fore and hind feet are four-toed. In some of the members of the family the claws can be withdrawn into sheaths as completely as in the cats, but in others they are only partially retractile; this difference depending to a great extent on whether the animals walk on their toes (digitigrade), or on the soles of their feet (plantigrade). None of the members of the

group attains large dimensions; and most of them are characteristic of Africa, Madagascar, and South-Eastern Asia, only two species entering the southern parts of Europe.

In their long, lithe bodies many of the family recall the weasels and their relatives, which belong to a very distinct group of Carnivora, the *Mustelidæ*; the resemblance being due to the similarity in the mode of life of the two groups, and not to affinity. As regards colouring, the *Viverridæ* exhibit a marked tendency to the

THE FOUSSA

development of dark spots, stripes, or bands on the body, accompanied in many cases by alternate dark and light rings on the tail; and thereby differ materially from the members of the weasel group.

THE FOUSSA

The foussa (*Cryptoprocta ferox*) of Madagascar, which is the largest carnivore found in that island, is the species alluded to above as connecting the more typical members of the present family with the cats. This peculiar animal differs, indeed, so remarkably from all the other representatives of the civet tribe that it has been considered by some naturalists that it ought to be referred to a separate family, while by others it is classed as a special subfamily of the cats.

In many features, however, it agrees so essentially with the civets that there are good grounds for associating it with that group. The foussa is a nearly uniformly coloured animal, with short and thick pale brown fur, and attains a total length of about five feet from the snout to the tip of the tail, the length of the tail being more than three-quarters that of the head



and body. The curved claws are sharp and retractile, and the feet, each of which is furnished with five claws, are very similar to those of a cat, except that the whole sole of the hind pair is naked, and applied to the ground in walking.

The foussa has a total of thirty-six teeth, of which the hind ones, both in form and number, closely resemble those of the cats. Thus the flesh tooth in each jaw is cat-like, while there is only a single small molar tooth behind the flesh tooth in the upper jaw, and none behind that of the lower jaw, so that the number of molars is $\frac{1}{2}$. Unlike living cats, the foussa

those of the dogs, and thus different from those of the cats; the upper flesh tooth having but two lobes to the blade, while the lower flesh tooth has a large heel behind its cutting blade.

Civets are further characterised by their long and flattened bodies, narrow and elongated heads, short limbs, and small and rounded feet, each being furnished with five toes, of which the claws are partially retractile, and the hairy soles of the feet, exclusive of the pads. With the exception of one species, the back has a crest of long hairs, which can be erected at will; the neck is marked by a black gorget; and the tail, which is of considerable

length, is variegated by alternate dark and light rings. The fur is long and rough-looking, and thus presents a marked contrast to the sleek coat of most of the cats. All civets walk on the very tips of their toes. In addition to the foregoing features, these animals are characterised by the great development of certain glands situated in the abdomen which secrete the well-known perfume which gives the name to the group.

There are several species of true civets, of which the majority are Asiatic, while one



THE AFRICAN CIVET

has four premolar teeth on each side of both jaws, and thereby resembles the typical civets, although the first of these teeth is generally shed at an early age.

With the exception that it is a purely nocturnal creature, of fierce disposition, scarcely anything is known with regard to the habits of the foussa in its wild state. This species was exhibited in the London Zoological Gardens for the first time in 1891.

Certain small cat-like animals described under the name of *Proaëurus*, the remains of which occur in the Oligocene Tertiary deposits of France, are believed to be nearly related to the foussa, and are accordingly included in the subfamily *Cryptoproctinae*. The determination is one of considerable importance, as if the *Carnivora* (and it may be added the birds) of Oligocene France are related to the modern Malagasy fauna, there is strong reason to believe in a relationship between the old French lemurs (*Adapis*) and those now found in Madagascar (see page 295).

TRUE CIVETS

The true civets, or civet cats (*Viverra*), forming the typical representatives of the family, are distinguished from the foussa by the number and form of their cheek teeth; the total number of the teeth being forty, of which on each side of both the upper and lower jaws there are three incisors, one canine, four premolars, and two molars. The flesh teeth, of which the characters have been already briefly mentioned, are like

is African. One Asiatic species is smaller than all the others, from which it also differs in the absence of the crest of erectile hairs on the back; and, from this and other differences, is frequently referred to a distinct genus. The true civets are nocturnal, and to a great extent solitary animals, and apparently some of them cannot climb.

THE AFRICAN CIVET

The African civet (*Viverra zibetha*), which is one of the larger members of the genus, inhabits the tropical portions of Africa and is brownish grey in ground-colour, marked with interrupted dark streaks, or blotches, over the whole body. The tail is dark-coloured, with the rings very indistinct in the terminal portion. Although little is recorded of the habits of this civet in the wild state, they are probably very similar to those of the next species. This civet, like other species belonging to the same genus, and also some of the other genera, is kept in cages for the purpose of obtaining the civet perfume, which is, however, now much less used in Europe than formerly. The civet of the Gabon and Congo districts has been distinguished as *V. poortmanni*, although it might perhaps be preferably regarded as a local race of the typical species.

THE INDIAN CIVET

This civet (*V. zibetha*) is an animal of nearly the same size as its African cousin, and has a total length of about 50 inches, 18 of these being occupied by the tail.

TRUE CIVETS

It is distinguished by having the erectile crest on the back of a deep black colour, thus forming a distinct black stripe running from the shoulders to the first ring on the tail, which is bordered on each side by a pale band. There are several dark bands on the chest, shoulders, and thighs, but the sides of the body are either plain-coloured or have very indistinct markings; the general colour of the fur being dark grey, frequently with a more or less decided yellowish or brownish tinge. The tail is marked with six black rings, which are much wider than the intervening white ones; its tip being black.

The Indian civet inhabits the eastern side of India, from Bengal to Sikkim, ascending to a considerable elevation in the Himalayas, and is also found in Burma, the Malay Peninsula, Siam, and Southern China. It is generally a solitary animal, hiding in woods, bushes, or thick grass during the day, but wandering into open country and often coming about houses at night. Not infrequently it is found in holes, but whether these are dug by the animal itself is doubtful. These civets are very destructive creatures, killing any birds or small mammals they can capture, and often attacking fowls, ducks, etc., although also feeding on snakes, frogs, insects, eggs, and on fruits and roots.

Civets take readily to water. The female produces during May or June three or four young at a birth, which are probably born with their eyes open. The Malabar civet (*V. civettina*) is a closely allied species, distinguished by the large transverse markings on the sides of the body.

THE MALAY CIVET

The Malay, or Burmese, civet (*V. megaspila*) may be recognised by the black line of the back being continued down the upper surface of the tail, in which the dark rings are continuous below, and at first not wider than the light interspaces. The sides of the body are marked with rather large and usually distinct spots, which may tend to coalesce into bands; and the terminal portion of the tail is black for a greater or lesser extent. This species seems to attain larger dimensions than the Indian civet, the total length of one example being $54\frac{1}{2}$ inches, of which the tail occupied $17\frac{1}{2}$ inches. It inhabits Burma, the Malay Peninsula, Cochin China, and Sumatra.

THE JAVAN CIVET

Another of the more typical species is the Javan civet (*V. tangalunga*), which is closely allied to the last, but distinguished by its smaller size and the incompleteness of the dark rings on the under side of the tail. This species has been recorded from Java, Sumatra, Borneo, and the Philippines, and also occurs in the islands of the Molucca group, where, however, it may have been introduced by the Malays, who are in the habit of carrying civets about in cages to the various islands, where they are bought for their secretion. Dr. Guillemard relates, on the authority of a Dutch informant, that in Java a so-called "wild cat," which is very probably this species, has the curious habit of eating ripe coffee berries for the sake of their fleshy external covering.

THE RASSE

The last species is the lesser civet, or rasse (*V. malaccensis*), the smallest member of the group, distinguished from the others by the absence of erectile hairs along the middle line of the back. It is a more slightly built and more sharp-nosed animal than the others, with more curved and slenderer claws. The ground-colour of the fur is some shade of brownish grey or yellowish brown, upon which are usually longitudinal dark lines down the back, and also rows of spots along the sides of the body. The dark rings on the tail vary from seven to nine in number. In size the rasse varies from 36 to 40 inches in length; from 15 to 17 inches of this being taken up by the tail.

This small civet is found over the greater part of India, although not occurring in Sind and the Punjab and some of the adjacent portions of Rajputana. It is also found in Ceylon, and extends eastwards from India, through Assam, to Burma and the Malay Peninsula, and thence to Southern China, Java, Formosa, and some other islands; and it has been introduced into Socotra, Madagascar, and the Comoro Islands.

The rasse differs from other civets in being a good climber and arboreal in its habits. It is, however, found in bush-covered districts rather than in thick forest, dwelling either in holes in the ground or among rocks. It feeds on such small animals as it can catch, and in confinement is easily tamed. If regarded as the representative of a genus by itself, the rasse should be known as *Viverricula malaccensis*. Some naturalists split the rasses into three species, which are, however, better classed as local races.

The comparatively large number of true civets inhabiting India and Malaysia, as contrasted with the



THE INDIAN CIVET

single representative of the genus found in Africa, suggests that in the later periods of the earth's history the Oriental region was the original home of the group. This is confirmed by what is known of their past history, for the remains of an extinct species have been found in a cavern in Madras, and those of two others in the Pliocene rocks of the Siwalik Hills in the north of India; one of the species from the latter district being

much larger than any existing civet. At a still earlier period—in the Lower Miocene and Oligocene—civets were inhabitants of Western Europe, their remains having been discovered both in England and on the Continent. This is another instance of the derivation of the modern mammalian fauna of the East from

a single specimen was recorded from the department of Eure, in the north of France. The species is definitely known in Syria, but may also occur in South-East Persia. Of the other species the handsome *G. victoriae* is East African, the blotched genet (*G. tigrina*) ranges from the Cape to Abyssinia, the feline genet (*G. felina*) is South African, while *G. senegalensis* and *G. pardina* are from the west coast. Genets are easily tamed; and in the south of Europe the common species is often kept in houses to kill rats and mice. When a genet is stealing through grass in pursuit of prey, with its long, lithe body stretched to the utmost and pressed close to the ground, and its tail extended straight behind, it looks more like a snake than a mammal.



THE JAVAN CIVET

the old European fauna, to which allusion has already been made. The old civets of Europe differ somewhat in the characters of their teeth from the living species, but appear in other respects to have been nearly allied. Comparatively few of the existing genera of mammals date so far back as the Oligocene period, and civets may be regarded as one of the oldest groups in the class. Madagascar is the home of a civet-like animal allied to the rasse, known scientifically as *Fossa daubentoni*, which must not be confounded with the foussa mentioned already.

GENETS

Among the graceful little animals known as genets (*Genetta*) is one of the two members of the civet family found in Europe. Although nearly related to the civets, genets may be distinguished by the greater proportionate length and slenderness of their bodies and their shorter legs, as well as by their longer and more tapering tails and shorter and blunter claws. The hind foot of a genet also differs from that of a civet in having a narrow naked surface extending for a long distance in the under surface behind the pads.

Another point of difference is to be found in the absence in the genets of a pouch for containing the civet-yielding secretion, a character in which they agree with the foussa. All these animals have short and soft fur, of which the ground-colour is brownish yellow or greyish. Along the middle of the back runs a black line, while the sides of the body are marked with black or brown spots; and there are also characteristic dark and light markings on the head and face. The black rings on the tail, which are variable in number, are generally narrower than the intervening white spaces.

As the civets are mainly Oriental in their distribution, having only one species beyond the limits of that region, so the genets are chiefly African. The common genet (*Genetta vulgaris*), which occurs in the northern part of Africa, is, indeed, the only species found beyond that continent, its range extending into Spain, the south of France, and South-Western Asia. In 1890

LINSANGS
The most beautifully coloured of the civet-like animals are the linsangs, of which there are three nearly allied Indo-Malay species, and a fourth from Africa. All the linsangs—the name would seem to be of Malay derivation—are characterised by their very long and slender bodies, the shortness of their limbs, the elongation of the head and neck, and the extreme length of the tail, which may exceed that of the head and body together. The claws can be completely withdrawn within their sheaths, the whole of the sole of the foot is generally hairy, and there is no scent-pouch.

The fur is characterised by its shortness and softness, and is very thick, so that the coat is almost like velvet pile. The ground-colour of the fur is some shade of tawny, marked with bold black spots or patches, the long tail being ringed with black. On account of their striking and handsome colouring, the name of tiger civets has been suggested for these animals.

Instead of the forty teeth found in the civets and genets, linsangs have only thirty-eight, this diminution being due to the loss of the second upper molar, so that there is only one tooth behind the flesh tooth of the upper jaw. All linsangs are carnivorous, but it is probable that some of them may also feed on insects. The Asiatic linsangs are characterised by the large size of their spots, which frequently form squarish patches, tending to form transverse bands. These species constitute the genus *Linsanga*.

The earliest known of these animals was the Javan linsang (*Linsanga gracilis*), from Java, Borneo, and perhaps Sumatra. It is the smallest of the linsangs, with a colouring similar to that of the next species, but with a somewhat different type of skull. The Burmese linsang (*L. maculosa*), which is the largest and perhaps the handsomest of the group, appears to be rare. The tail—the length of which, including the hair at the tip, is just under 17 inches—is slightly shorter than the head and body, which together measure about 19 inches. The body has a greyish ground-colour, marked with about six very broad and somewhat irregular brownish black transverse bands extending across the back, and separated by very narrow intervals.

On the flanks and neck of this animal the markings form broken longitudinal lines and spots, one very distinct line always extending from behind the ear to the shoulder. The outer surfaces of the fore limbs and of the thighs are spotted; and the tail has seven complete dark rings, separated by narrower light interspaces, its tip, as in the case of the genets, being lighter.

The spotted linsang (*L. pardicolor*), which is found from the South-Eastern Himalaya to Yunnan, is a

PALM CIVETS

somewhat smaller animal, the length of the head and body being only about 15 inches. It is distinguished by its colouring, the back being marked with longitudinal rows of large oblong spots, instead of the transverse bands of the last species.

AFRICAN LINSANG

The African linsang (*Poiana poënsis*) ranges from the west coast, in Guinea, Sierra Leone, and Fernando Po, to the Mombattu district of Eastern Central Africa. The tail is somewhat longer than the head and body, measuring fully 40 inches, while the total length of the head and body is but 38 inches. The spots are smaller than in the Oriental linsangs, and, with the exception of some stripes on the back of the head and a line extending from the neighbourhood of the ear to the shoulder, do not run together into lines or patches. A naked line runs up the sole of the hind foot, as in the genets. The tail is peculiar, in that the broad light rings separating the large dark bands are divided in the middle by very narrow dark rings.

PALM CIVETS

The palm civets, tree cats, or toddy cats, as they are indifferently called, constitute an Asiatic group of several genera, with one or two outlying West African species, of civet-like animals, differing in several important respects from all the preceding species, which are more or less closely allied. The number of the teeth is forty, the same as in the civets; but the individual teeth are usually much smaller in proportion to the size of the skull, and the flesh teeth are by no means of such a markedly cutting type. There

India and Burma, through the Malay region, to the south of China, and also occurring in the Philippines, Celebes, and Formosa. They may be either uniformly coloured or striped, and, with one exception, have



THE PARDINE GENET

no rings on the tail, which is very long, but not prehensile.

In size most of them may be compared to a large domesticated cat with relatively short legs. Their ears are small and rounded, the pupil of the eye is vertical, and the claws are completely retractile. The most distinctive external feature is to be found in the soles of the feet, which, in both the fore and hind limbs, are almost completely naked; the bald area being continued backwards from the foot-pads without the intervention of any hairy space.

Palm civets are purely nocturnal and thoroughly arboreal; their food, in accordance with the structure of their teeth, consisting in part of animal and in part of vegetable substances. The name *Paradoxurus*—often anglicised into paradoxure—was given to these animals on account of a caged specimen in Paris having its tail coiled up in a peculiar manner. It was believed that this was the normal condition, and that the tail could be used as a prehensile organ. It appears, however, although the palm civets have naturally some power of coiling and uncoiling their tails, that the permanently coiled condition shown in the Paris and some other caged specimens is a kind of disease due to the effects of captivity.

Altogether there are about a dozen well-distinguished species of typical palm civets, five of which are found in India and Burma. In most of these the tail is more than half the length of the head and body, and uniformly coloured. The Celebes palm civet (*P. musschenbroeki*), however, is distinguished by having the tail banded with indistinct rings of darker and lighter brown. The imperfectly known woolly palm civet (*P. laniger*), described upon the evidence of a single skin reported to have been obtained from



GENETS

are also important distinctions in the structure of the skull. In most cases the tail is uniformly coloured, or only ringed at its base. All these animals are mainly arboreal in their habits.

The typical palm civets constituting the genus *Paradoxurus* are exclusively Asiatic, ranging from

North-Western China, differs from the rest in the woolly nature of its fur, and also in the length of the tail not exceeding that of the head and body. It is not certain that it really belongs to the same genus as the other species. Another species (*P. macrodus*), from the Malay region, was first described on the evidence

of a skull remarkable for the large size of its cheek teeth. A species common to the Philippines and Borneo has been named *P. philippensis*, the Andaman form being distinguished as *P. tytleri*.

INDIAN PALM CIVET

The best known of all the species is the Indian palm civet (*P. niger*), found throughout the greater part of India and Ceylon, in which the tail is nearly or quite as long as the head and body; and the general colour of the coarse and somewhat ragged fur is a blackish or brownish grey, without any stripes across the back in fully adult individuals. The length of the head and body of the male is $22\frac{1}{2}$ inches, and that of the tail $19\frac{1}{2}$ inches; the corresponding dimensions in the female being in one instance 20 and $17\frac{1}{2}$ inches, and in a second about 18 inches for each portion.

This species is common in Bengal, and in the gardens of the suburban residences of Calcutta may occasionally be seen in the late afternoon or evening crawling among the leaves of a palm before starting on its nocturnal wanderings. The name of toddy cats is applied to these animals from the partiality which, in common with flying foxes, they display in Southern India and Ceylon for the palm-juice, or toddy, collected by the natives in vessels suspended on the trees. Like the other members of the group, the Indian palm civet, when irritated, gives forth a most unpleasant odour.

MALAY PALM CIVET

The Malay palm civet (*P. hermaphroditus*) occurs throughout the countries to the east of the Bay of Bengal as far as Siam, and is distinguished from its Indian congener by the presence of a pale-coloured band running across the forehead, and also by the presence of stripes across the back in the adult condition. In both the preceding species the "whiskers" are black, but in the golden palm civet (*P. aureus*) of Ceylon, and also the brown palm civet (*P. jerdoni*) of Southern India, they are respectively rufous and dark brown; the body colour in these two species being nearly the same as that of their whiskers. On the other hand, the Himalayan palm civet (*P. grayi*), which occurs throughout Sikkim and Assam, is easily distinguished by its white whiskers; while it is further characterised by the great backward production of the bony palate of the skull. The golden palm civet is said to be less carnivorous than the other species.

The Chinese palm civet (*P. larvatus*) is closely allied to the Himalayan species, but differs in the browner tinge of its greyish fur, and in the markings on the head being very distinct, and black and white in colour; it has also a broad white band running down the head and nose. It is rather smaller than the Himalayan palm civet. In Southern China this palm civet is found in Hangchow, and the provinces of Kwangtung and Fokien, and it likewise inhabits the island of Formosa.

SMALL-TOOTHED PALM CIVETS

Certain species of palm civets are distinguished from the members of the preceding genus, among other characters, by their relatively smaller cheek teeth,

and accordingly have been referred to a distinct genus (*Arctogale*, or *Arctogalidia*). Externally, these small-toothed civets may be distinguished from the typical palm civets by the soles of their feet being still more extensively naked, and by the greater degree of divergence of the first toe of both pairs of feet from the other digits. The white-eared palm civet (*A. leucotis*) is an inhabitant of Assam, Burma, Tenasserim, the Malay Peninsula, Sumatra, and Java; a second species (*A. trivirgata*) is restricted to the island last mentioned; and a third (*A. stigmata*) has been described from Borneo.

The white-eared species is a short-furred animal, of a tawny or dusky grey colour, sometimes nearly brown on the back, and always paler below, with a tail about as long as the head and body. It is distinguished by the presence of three dark bands, which may be either continuous or broken up into spots, running down the back of the otherwise uniformly coloured body. In a male specimen, the total length of the head and body was $26\frac{1}{2}$ inches, and that of the tail 27 inches. When taken young it can be readily tamed. The small size of the cheek teeth—especially the nearly triangular form of the upper flesh tooth—suggests that it feeds largely upon vegetable substances. The second species (*A. trivirgata*) is closely allied, having three similar dark stripes down the back.

BANDED & AFRICAN PALM CIVETS

Another type of palm civet is represented by Hardwicke's palm civet (*Hemigale hardwickei*), of the Malay Peninsula, Sumatra, and Borneo, and Hose's palm civet (*H. hosei*), confined to Mount Dulit, in the north of Borneo. These species are distinguished from other palm civets by having a much smaller portion of the soles of the feet naked, and by their colouring, which is different from that of any other representative of the family, although approached to some extent by that of the linsangs. The characteristic colouring takes the form in Hardwicke's palm civet of a variable

number of broad transverse dark bands crossing the back, of which the ground-colour is pale brownish grey, the number of these bands being generally either five or six. There are also some dark longitudinal stripes on the nape of the neck, and the upper half of the tail is banded with dark rings. A peculiarity of these animals is that the direction of the hair on the back of the neck is reversed. Their habits are probably very similar to those of other palm civets.

The last member of the group is the African palm civet (*Nandinia binotata*),

which, although nearly allied to the Oriental species, is distinguished by certain structural peculiarities in the skull, and also by having a shorter muzzle than any other member of the family.

The fur is greyish brown in colour, with the back and sides marked with large dark spots, and a pale spot on each side of the shoulders, from which it takes its second scientific name. The tail, which is about two-thirds the length of the head and body, is indistinctly ringed with dark bands. In size this species is rather smaller than the average of the typical palm civets. The African palm civet is typically a native of the west



THE CHINESE PALM CIVET

TRUE MUNGOOSES

coast, where it occurs from Sierra Leone, Guinea, and the Congo to Angola. Probably it extends across the central districts of the continent, as it is represented in the Nyasa district of Eastern Central Africa by an allied animal, which has been described as a distinct species under the name of *N. gerrardi*, but may be only a local case of the typical species.

Several West African mammals are known to be of an ancient type, and it has been pointed out by Miss A. Carlsson that the two-spotted African palm civet is nearly related to *Amphictis*, an extinct civet-like genus from the Oligocene of France. *Nandinia* is also peculiar in possessing a kind of rudimentary abdominal pouch, the presence of which led one writer to suggest that the creature is a marsupial.

BINTURONG

The binturong, or bear cat (*Ayctictis binturong*), although nearly allied to the palm civets, is the sole representative of its genus, and has a rather wide distribution in the Oriental region, ranging from Assam, through Arakan, Tenasserim, Siam, and the Malay Peninsula, to Sumatra and Java. It is distinguished from all other members of the civet family by the long tufts of hair surmounting the ears, and also by the prehensile nature of the very long and somewhat bushy tail. As regards size, the length of the head and body varies from 28 to 33 inches, and that of the tail from 26 to 27 inches. The tail is characterised by its great thickness at the root, from which it tapers gradually; it is covered with bristly, straggling hairs, exceeding in length those of the body. The whole of the fur is long and coarse, especially on the back, and is of a uniform black tint, more or less washed with grey on the head and fore limbs and occasionally all over the body.

The cheek teeth, although of the same general type, are even proportionately smaller than in the small-toothed palm civets, with which they agree in number; but the last molar tooth in the upper and the first premolar in the lower jaw may be wanting.

The peculiarities in the teeth, coupled with other structural characteristics, lead to the conclusion that the binturong is a highly modified and specialised member of the palm civet group, of which the nearest relatives are the small-toothed palm civets. Dr. Blanford observed that it "is omnivorous, living on small mammals, birds, fishes, earthworms, insects, and fruits; it is also nocturnal and arboreal, its power of climbing about trees being much aided by its prehensile tail. It is rather slow in its movements. Its ability to suspend itself by its tail has been questioned, but Blyth has shown that the young, at all events, can support itself by the extremity of the tail alone. The binturong is said to utter a loud howl. It is naturally fierce, but when taken young is easily tamed, and becomes very gentle and playful. Of its breeding nothing appears to be known." It has been stated that when young the binturong is spotted.

WATER CIVET

As the palm civets and the binturong represent the arboreal type of the civet family, so the water civet (*Cynogale bennetti*) presents a form adapted to a

partially aquatic mode of life. This animal is an inhabitant of the eastern part of the Oriental region, where the civet tribe attains its greatest and most peculiar development, being found in the Malay Peninsula and the islands of Borneo and Sumatra. In appearance it somewhat recalls a small otter, the muzzle being very broad and furnished with thick bristles, while the body is shorter and stouter than in other members of the family, and the tail unusually short, its total length being only some 6 inches, while that of the head and body is upwards of 24 inches.



THE MALAY PALM CIVET

The toes of the feet are webbed at their bases, and are further remarkable for their shortness. The teeth are forty in number, as in the case of the palm civets, but the premolars have unusually tall crowns, apparently adapted to hold and bite the fish, upon which this civet largely subsists. According to Dr. A. R. Wallace, this animal, which appears to be exceedingly rare in Borneo, not only swims well and readily, but is also said to be a good climber. In addition to fish, crabs, etc., it is reported to eat the flesh of such land animals as it can catch and various fruits.

TRUE MUNGOOSES

The time-honoured name *ichneumon*, applied to the Egyptian representative of the group of civet-like animals now claiming attention, has been generally rejected by naturalists in favour of the term mungoose, the native Indian name for an Oriental species. The mungoosees form a well-defined group of small civet-like animals, with very long and generally uniformly coloured bodies and tails, which differ in several important characteristics from the members of the family hitherto noticed. A large number of the mungoosees are included in the typical genus *Herpestes*, of which the range includes not only Africa, but also the Indian and Malay countries, and of which one species is found in Spain. The other genera of mungoosees come from Africa, which may be regarded as the headquarters of the group.

Mungoosees differ from all the members of the civet family hitherto described in several important modifications in the structure of the skull. The socket of

the eye, or orbit, is very frequently surrounded by a complete bony ring—while in all the forms already noticed it is widely open behind—and the teeth are always relatively tall, with sharp cusps adapted for a thoroughly carnivorous diet. Mongooses may be distinguished by their long, straight claws, which are incapable of retraction, and are therefore always pro-



THE WATER CIVET

truded, like those of a dog; and no mongoose ever has scent-glands comparable to those present in the true civets and palm civets. So important are these differences that naturalists divide the members of the civet tribe into three primary groups, or subfamilies; the first being represented solely by the foussa of Madagascar; the second including the true civets, genets, palm civets, etc.; and the third the mongooses and their allies. The mongooses have even been separated as a distinct family, the *Herpestidae*.

The true mongooses, or those constituting the genus *Herpestes*, have long, weasel-like bodies, and a more or less elongated tail, generally thick at the root and covered with long hair; its colour being like that of the body, but the tip often darker. The longer hairs of almost all the mongooses are marked with alternate darker and lighter rings, which communicate a peculiar and characteristic speckled appearance to the fur. The head has a pointed muzzle—with a rather short nose—in which there is a median groove on the completely naked under surface. The ears are small and rounded.

The limbs are of extreme shortness, and the feet are provided with five toes, of which the first, both in front and behind, is very small. The toes are generally detached, but may be slightly connected by a small web at their bases. The under surfaces of the fore feet are usually naked, and in most cases only the front part of the soles of the hind feet is free from hair. Most mongooses have the same number of teeth as the true civets, namely, forty; but, owing to the loss of a premolar on each side of the lower and upper jaws, in some species the number may be reduced to thirty-six.

The true mongooses range over the greater part of Africa, extending across the Strait of Gibraltar into Spain, and eastwards throughout the south of Asia as far as the islands of the Malay region. The number of species belonging to the typical genus is comparatively large, Africa claiming about half a score, among which is the one ranging into Spain, while there are nearly as many from India, Ceylon, and Burma. In respect of size, mongooses exhibit a considerable degree of variation, for while the head and body of the smaller species may be compared to those of a weasel, the larger forms rival a domesticated cat in dimensions.

Mongooses are terrestrial Carnivora, seeking their prey on the ground and very rarely climbing trees. They are active, bold, and predaceous, and live on small mammals, birds, reptiles, insects, and eggs, and occasionally eat fruit. They are deadly enemies to snakes, and, for the most part at any rate, live in holes in the ground, hollow trees, and similar places. When angry or excited, they erect their long hairs, and especially those of the tail.

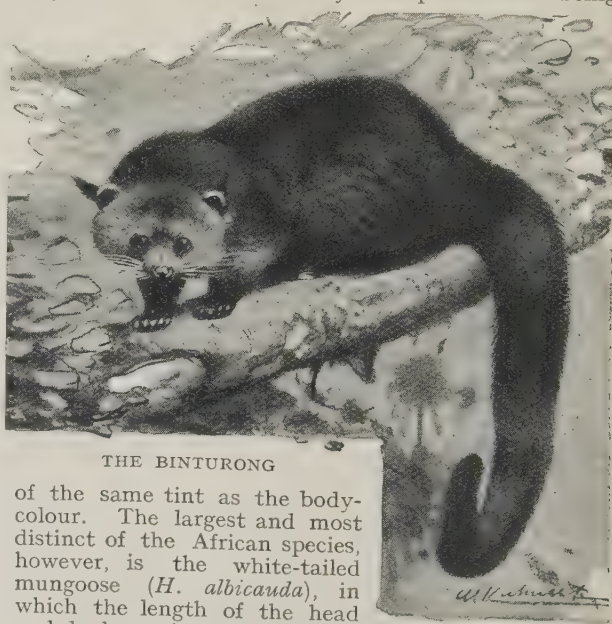
THE EGYPTIAN MUNGOOSE

The typical representative of the genus is the Egyptian mongoose, or *ichneumon* (*H. ichneumon*), inhabiting Africa north of the Sahara, Palestine, Asia Minor, and the southern portions of Spain. One of the sacred animals of the ancient Egyptians, it is often depicted on their frescoes, and is popularly known as "Pharaoh's mouse." It is reported to feed largely on the eggs of crocodiles, although this habit has not been recorded of any of the Indian species; and it displays similar antipathy to snakes to that exhibited by the Indian species. The Egyptian mongoose is a large species, the length of the head and body being about 20 inches, and that of the tail some 15 or 16 inches. It is characterised by the tip of the tail being black and by the grizzled grey-brown colour of the fur, in which the individual hairs are ringed with reddish brown and creamy yellow. South of the Sahara this species is replaced by the slightly larger but closely allied Kaffir mongoose (*H. caffer*), in which the hairs are ringed with black and white.

In South Africa, as far north as Zanzibar, there is a much smaller species, the slender mongoose (*H. gracilis*), agreeing with the two preceding forms in the black tip of the tail; while in Kordofan the nearly equal-sized red-tailed mongoose (*H. sanguineus*) is distinguished by its general fawn-coloured fur and the red tip to the tail.

THE WHITE-TAILED MUNGOOSE

Certain other South and West African mongooses of large size are characterised by the tip of the tail being



THE BINTURONG

of the same tint as the body-colour. The largest and most distinct of the African species, however, is the white-tailed mongoose (*H. albicauda*), in which the length of the head and body varies from 22 to as much as 26 inches. This striking species is distinguished from all the foregoing by the under surface of the ankle being hairy, instead of nearly or quite naked, and also

TRUE MUNGOOSE

by its bushy tail. The general colour is blackish grey, the longer hairs being ringed with black and white, and having the tips black. The white-tailed mongoose presents remarkable variation in the colour of the fur of the tail; the hairs, which are of considerable length, having in some cases white bases and long shining black tips, so that the whole tail appears to be black, while in others there is a long white tip beyond the black, so that the tail appears to be white, the hairs at the extreme tip in the latter case being generally wholly white. This species ranges from the eastern part of Abyssinia to Natal, and reappears on the west coast in the Guinea district.

THE INDIAN MUNGOOSE

Of the eastern species, special notice may be accorded to the Indian mongoose (*H. mungo*), which belongs to a group of several species characterised by their uniform colouring, having no stripe on the neck and no black tip to the tail. It is a comparatively large species, with rather long hair, of which the general colour is grey or rufous; the length of the head and body varying from 15 to 18 inches, and that of the tail from 14 to 15 inches. This species is found throughout peninsular India, from the Himalaya to Cape Comorin, and also occurs in Ceylon, although unknown in the countries to the east of the Bay of Bengal.

This mongoose, writes Dr. Blanford, "is found in hedgerows, thickets, groves of trees, cultivated fields, banks of streams, and broken bushy ground, but not commonly in dense forests. It is often found about houses, and lives and breeds in holes dug by itself. Very little appears to be known of its breeding habits. It is oftenseen in pairs, and the young are three or four in number, and produced in the spring. The food of this animal is varied. It lives principally upon rats and mice, snakes and lizards, such birds as it can capture, eggs, and insects; but it eats fruit at times. The stomach of one killed near Secunderabad contained a quail, a small wasp's nest, a lizard, a number of insects, and part of a custard-apple."

This animal, for its size, is decidedly fierce and bloodthirsty. Dr. Jerdon states that "not infrequently it gets access to tame pigeons, rabbits, or poultry, and commits great havoc, sucking the blood of several. I have often seen it make a dash into a veranda where some cages of mynas, parakeets, etc., were daily placed, and endeavour to tear the birds from their cages." In spite of its natural fierceness, the mongoose is easily tamed, and forms a gentle and affectionate pet. Tamed mongooses are carried about in India by snake-charmers and other showmen.

Much has been written as to the combats of both the Egyptian and the Indian mongoose with venomous snakes, and also as to the alleged immunity of these animals from snake poison. On these points Dr. Blanford wrote as follows: "The prevalent belief throughout Oriental countries is that the mongoose, when bitten, seeks, for an antidote, a herb or root known in India as *manguswail*. It is scarcely necessary to say that the story is destitute of foundation. There is, however, another view, supported by some evidence,

that the mongoose is less susceptible to snake poison than other animals are. The mongoose is not always willing to attack, though at other times he is ready enough to fight. I have not seen many combats, but, so far as I can judge from the few I have witnessed, Jerdon and Sterndale are correct in their view that the mongoose usually escapes being bitten by his wonderful



THE WHITE-TAILED MUNGOOSE

activity. He appears to wait till the snake makes a dart at him, and then suddenly pounces upon the reptile's head, and crunches it to pieces. I have seen a mongoose eat up the head and poison glands of a large cobra, so the poison must be harmless to the mucous membrane of the former animal. When excited, the mongoose erects its long, stiff hair, and it must be very difficult for a snake to drive its fangs through this and through the thick skin which all kinds of *Herpestes* possess. In all probability a mongoose is very rarely scratched by the fangs, and, if he is, very little poison can be injected. It has been repeatedly proved by experiments that a mongoose can be killed, like any other animal, if properly bitten by a venomous snake, though even in this case the effects appear to be produced after a longer period than with other mammals of the same size." Nowadays, however, there is reason to believe that the blood of the mongoose, like that of the garden doormouse, is immune, at least in a great degree, to serpent venom.

In addition to being a benefactor to the human race as a destroyer of poisonous snakes, the Indian mongoose, like its Egyptian cousin, is equally valuable as an exterminator of rats, ships having more than once been cleared of these pests in a comparatively short period by the introduction of a mongoose. During and about the year 1871 the sugar-planting industry in Jamaica was threatened with annihilation from the damage inflicted on the canes by a particular species of rat which swarmed in the island. After ferrets, toads, and ants had been tried with more or less ill-success to stay the plague, the Indian mongoose was introduced, and within three years the rats were

practically exterminated, though at the cost of serious damage to native animals. This eventually gave rise to a great increase of noxious insects, which, in turn, played havoc with the sugar-canes. The loss thus incurred led to the abolition of the mungoose from the island.

The small Indian mungoose (*H. auro-punctatus*) is a member of the same group as the preceding species, but of rather smaller dimensions, with closer and shorter fur, in which the

hairs of the back do not have more than five coloured rings. This is a northern species, not found in India to the south of Calcutta, and ranging into the Himalaya as far north as the valley of Kashmir; while westwards its range includes Baluchistan and portions of Afghanistan and Persia, and eastwards extends through Assam into Upper Burma. In Kashmir it may frequently be seen in the Moham-

medan burying-places, where it inhabits old graves. The ruddy mungoose (*H. smithi*) is widely distributed in India, and distinguished by the black tip of its tail and the absence of a stripe on the throat. The striped mungoose (*H. vitticollis*), the largest of all the Asiatic species, is distinguished by having a black tip to the tail and a black stripe down each side of the neck. It inhabits Western India, from Bombay to Cape Comorin, and is also found in Ceylon.

THE CRAB-EATING MUNGOOSE

The crab-eating mungoose (*H. urva*) is remarkable on account of its peculiar habits. This species is rather smaller than the preceding, and characterised by its thick and heavy build, the uniformly coloured tail, and the presence of a narrow white stripe running along each side of the neck, from the angle of the mouth to the shoulder. The crab-eating mungoose is found at low elevations in the South-Eastern Himalaya, as well as in Assam, Arakan, Pegu, Tenasserim, and the south of China. Of partially aquatic habits, it derives its name from the crabs which, with frogs, are asserted to form its chief food.

The true mungoses include the large Javan *H. javanicus* and the short-tailed *H. brachyurus* from the Malay Peninsula and islands, and the barred *H. semitorquatus* from Borneo. A few African true mungoses have only three premolar teeth, a distinct gap between the tusk, or canine tooth, and the premolar corresponding with the second in those species that have four of these teeth.

SHORT-TAILED MUNGOSES

There occur in Africa two small mungoses with only three premolar teeth, of which the front pair is placed close up to the tusk, so that there is no gap in the series. These species are also distinguished from their African relatives by their shorter tails, of which the length is less than that of the body alone, and have accordingly been referred to a distinct genus, *Helogale*.

Of the two species, the one named *H. parvula* is an inhabitant of Natal, and is greyish brown in colour; while the other, *H. undulata*, comes from the Mozambique district, and has the hair of a grizzled rufous tint. Both have naked soles to the hind feet.

FOUR-TOED MUNGOSES

In the typical mungoses the first toes in both fore and hind feet are of extremely small size, and this is

more marked in the hind than in the fore feet, while in both limbs these digits appear to be of no functional use. There are, however, certain African mungoses in which even this small first toe disappears either in the hind limb alone, or in both hind and fore limbs. All these species have four premolar teeth on each side of each jaw, and are further characterised by the hairiness of the soles of the hind



THE MUNGOOSE

feet. The thick-tailed mungoose (*Cynictis penicillata*) is the typical representative of its genus which is characterised by having four toes on the hind foot and five on the fore foot. This species, which inhabits Cape Colony, is of medium size, and distinguished by its bushy, white-tipped tail, and the peculiar greyish yellow of its fur, which is liable to some degree of individual variation. In East Africa it is represented by *C. selousi*. The two species (*Bdeogale crassicauda* and *B. puisa*) of the genus *Bdeogale*, respectively from Mozambique and Zanzibar, are distinguished by having but four toes on both fore and hind feet. Both the latter species are closely allied, differing mainly in the colour of the hairs of the tail.

SMOOTH-NOSED MUNGOOSE

The remaining members of the mungoose group, all of which are African, differ from the whole of the preceding in having no median vertical groove between the nose and the upper lip. They are referred to three different genera, of which the two here mentioned have five toes on each foot. Meller's mungoose (*Rhynchogale melleri*) is an East African species, of interest not only on account of its being the sole representative of the genus to which it belongs, but also on account of its rarity in collections. It is of about the same form and size as the Egyptian mungoose, with the full number of premolar teeth, and the soles of the hind feet completely covered with hair so far as the roots of the toes. The tail is about equal in length to the body, and the general colour uniform pale brown, becoming lighter on the head, the hairs having but one or two rings of different colours.

CUSIMANSE AND BANDED MUNGOSES

Certain other mungoses constitute the genus *Crossarchus*, distinguished by having only three pairs of premolar teeth in each jaw, and likewise by the under

surface of the hind feet being completely naked. A further distinction is to be found in the fact that while in Meller's mongoose the palate of the skull is concave, in the members of the present genus it is completely flat. All are of burrowing habits. Of these species, the cusimanse (*C. obscurus*), ranging in West Africa from the Cameroon Mountains to Sierra Leone, and the Gambian mongoose (*C. gambianus*) of the Gambia have uniformly coloured and grizzled fur; the former being of a dull brown colour, with yellow tips to the hairs, while the latter is grey, with the hairs ringed. On the other hand, the zebra mongoose (*C. zebra*), ranging from Abyssinia to the Congo, and the banded mongoose (*C. fasciatus*) of Eastern and Southern Africa have the back banded with transverse stripes, which are narrow in the former and broad in the latter (page 313).

The zebra mongoose is further distinguished by the rufous colour of the under parts, while in the banded species the colour of the under surface of the body is grizzled grey. At least two other species of the genus have been named.

THE MEERKAT

The meerkat (*Suricata tetradactyla*) of the Cape Colonists, or suricate, as it is frequently called by naturalists, while agreeing with the two genera last mentioned in the absence of a groove below the nose, differs from both in having only four toes on each foot. It is further characterised by having three premolar teeth on each side of the upper jaw, and four on the lower jaw, so that the total number of teeth is thirty-six. The soles of the hind feet are naked.

The meerkat is a graceful little animal of slender form, with a tail of about half the length of the head and body. The fur is long and soft, of a light grizzled grey colour, with black transverse stripes across the hind part of the back, the under parts rufous, the head nearly white—except for a black mark round the eyes—the ears black, and the tail yellowish, with a black tip. The longer hairs are broadly ringed with black and white, the white predominating. The transverse light and dark bands on the loins are formed by the regular arrangement of the hairs, in consequence of which the white and black rings come opposite to each other on adjacent hairs. Meerkats may be distinguished from all other mongooses by the elongated nose and claws, as well as by their peculiar colouring, no other species having ears differing in colour from the rest of the head.

Meerkats appear to be confined to Cape Colony, extending at least as far north as Algoa Bay. Their habits have been described by Mrs. A. Martin, who states in her "Home Life on an Ostrich Farm" that they form most admirable and amusing pets, nearly every homestead on the Karroo having one or more of them. In their wild state meerkats live in colonies or

warrens, burrowing deep holes in the sandy soil, and "feeding chiefly on succulent bulbs, which they scratch up with the long, curved, black claws on their fore feet. They are devoted sun-worshippers, and in the early morning, before it is daylight, they emerge from their burrows, and wait in rows till their divinity appears, when they bask joyfully in his beams. They are very numerous on the Karroo, and, as you ride or drive along through the veldt, you often come upon little colonies of them sitting up sunning themselves, and looking, in their quaint and pretty favourite attitude, like tiny dogs begging. As you approach, they look at you fearlessly and impudently, allowing you to come quite close; then, when their confiding manner has tempted you to get down in the wild hope of catching one of them, suddenly all pop so swiftly into their little holes that they seem to have disappeared by magic." Although in the Cape it appears that the name "meerkat" is also often applied to the thick-tailed mongoose (*Cynictis*), it is the true meerkat alone which makes such a charming pet.

MALAGASY MUNGOOSE

It is convenient to allude under the name of mongooses to certain very curious members of the civet tribe which inhabit Madagascar. These are arranged under four distinct genera, of which the first three are nearly allied to one another, and are also related to the African mongooses, while the fourth is very different from other Malagasy mongooses, and is indeed an altogether aberrant modification of the family.

The munguste (*Galidictis striata*) is one of two nearly allied species characterised by having the ground-colour of the fur of a light tint, marked by longitudinal dark stripes on the body, this peculiar type of colouring being alone quite sufficient to distinguish these animals from all their allies. The munguste measures about $12\frac{1}{2}$ inches in length, exclusive of the tail, the latter being rather shorter than the head and body. The tail is bushy in both species, and the claws are longer than in the true mongooses. In the munguste the snout is rather short, but it is more elongated in the other species (*G. vittata*), and the claws are longer than in the true mongooses.

The galidia (*Galidia elegans*), the only representative of its genus, differs from the munguste in having the fur of the body uniformly coloured, but the tail is ringed with black bands, the hairs being of one colour throughout their length. The

two species of the allied genus *Hemigalidia*—namely, *H. unicolor* and *H. olivacea*—differ in the tail being of the same uniform colour as the head and body, and also in the more pointed muzzle and the smaller curvature of the claws.

The most remarkable of these four types of Malagasy carnivores, however, is *Eupleres goudoti*, in which the most peculiar characteristic is the very small size of the teeth and the weakness of the jaws. The teeth, of which



THE MEERKAT

the number is the same as in the civets (forty), are, indeed, much more like those of an insectivore than a carnivore, most of them being separated from one another by spaces; the tusks, or canines, are not longer than the front teeth, and the flesh tooth is scarcely distinguishable from the adjacent teeth. The length of the head and body of the eupleres is about $19\frac{1}{2}$ inches, the tail being about one-third of this length. The body is covered with a uniformly coloured woolly fur, of which the general tint is olive, finely speckled with yellow; this speckled appearance being due to the hairs being banded with differently coloured rings. The ears are large, the short tail is bushy, the feet, which are furnished with five toes, are remarkable for their extreme slenderness, and the claws are long and like those of the typical mungoses. In the young eupleres the fur of the shoulders has black transverse stripes. It does not appear that anything is known of the habits of this rare, and doubtless nocturnal, creature, but the weakness of its teeth and jaws suggests that its food consists rather of insects than of flesh.

THE AARD WOLF

The remarkable animal known to the Boers of South Africa as the aard wolf, or maned jackal, has long been a puzzle to naturalists. It is allied in many respects to the hyænas, but in others is so different that it becomes exceedingly difficult to decide if it should be included in the same family; many naturalists are inclined to regard the aard wolf (*Proteles cristatus*) as the solitary representative of a distinct family—the *Proteleidæ*.

In size it has been compared to a large and "leggy" fox, while in external appearance the aard wolf, known to the Kaffirs as the isidawane, somewhat resembles a rather small and thin-bodied striped hyæna, with longer ears and a more pointed muzzle. The fur, which is inclined to be shaggy and of a woolly nature, is of a yellowish or reddish brown colour, marked with about half a dozen transverse black stripes on the sides of the body; and there may also be some dark bars on the limbs. The long tail is thickly haired. The elongated hair on the back forms a kind of crest, giving origin to the second scientific name of the aard wolf, which can be erected at will. The claws, like those of hyænas, are not capable of retraction, and are rather long, with blunted extremities. Hyænas, however, have only four toes on both the front and hind feet, whereas the aard wolf has five toes on the front and four on the hind feet.

But the most peculiar feature of the species is to be found in the almost rudimentary condition of the teeth, which may be either thirty or thirty-two in number, this reduced size being most apparent in those of the cheek series, which are widely separated from one another and

EXTINCT CIVET-LIKE ANIMALS.

Remains of mungoses, referred to the typical genus *Herpestes*, are found in the Upper Oligocene and Miocene rocks of France. In these formations also occur the bones and teeth of animals more nearly allied to the linsangs; while others, again, appear to connect the civets with the weasels—a connection which would have been wholly unsuspected if science had only existing animals to deal with. In a later geological epoch—the lower part of the Pliocene—there occurs another interesting type, *Ichthyerium*, the members of which so completely connect the civets with the hyænas as to prove conclusively the close alliance of these two families.

At a still earlier date are found, both in Europe and North America, remains of other civet-like animals differing so markedly from all existing types that they are assigned to a separate family—the *Palæonictidæ*. Some of these lower Eocene civets were of very large size. The group includes the European *Palæonictis* and the American *Amblyctonus* and *Æurotherium*.

quite unlike the strongly developed teeth of the hyænas. The skull, while agreeing in many respects with that of the hyænas, has also certain points of resemblance with those of the mungoses. The aard wolf may, in short, be regarded as an animal which in all probability originated from the same ancestral civet-like creatures from which the hyænas were derived, but has undergone a kind of retrograde development to suit the needs of a particular mode of life. Although long supposed to be confined to South Africa, it has been found to range on the west coast as far north as Angola, and also occurs

in Somaliland, so that it doubtless extends all along the eastern side of the African continent.

According to the accounts of travellers, the aard wolf is a comparatively rare animal, although this apparent rarity may in some degree be due to its purely nocturnal habits. As its name implies, it lives in burrows, which are made by itself, and, according to the account of the traveller de Lalande, several individuals may

inhabit one and the same burrow, which has generally at least two or three exits. Like all burrowing animals, it is of a timid and cowardly disposition, and when driven from its earth makes off at a rapid pace. The aborted condition of the teeth would alone suffice to indicate that it subsisted on a diet different from that of ordinary Carnivora, and that such is really the case has been proved by observations made upon both wild and captive specimens. In the wild state, its chief food consists partly of carrion and partly of the so-called white ants, or termites, which it digs out of their hills with its strong claws.



THE EUPLERES

HYÆNAS

HYÆNAS are confined to the warmer part of the Old World, but are unknown west of the Caucasus and in the countries lying to the east of the Bay of Bengal, although in past epochs they were spread over the greater part of Europe, and ranged as far east as China. At no period, however, was the group represented in the New World.

The existing species of hyænas are three in number, all being included in the single genus *Hyæna*, which thus, if the aard wolf be excluded, forms the sole representative of a distinct family (*Hyænidæ*). With the exception of the aard wolf, the nearest relatives of the hyænas are the civets; but at the present day the two families are markedly distinct, although the extinct *Ichitherium*, as already mentioned, blends them so closely that it is almost impossible to say where civets end and hyænas begin.

Hyænas are heavily built animals, with relatively long legs—especially the front pair—deep bodies, short and broad heads, and rather short tails; their whole appearance being ungainly and repulsive. Their fur is coarse and shaggy, and marked, more or less distinctly, with either irregular vertical stripes or large blackish spots. The feet have but four toes, on both the front and hind limbs; and are furnished with stout claws, which are permanently protruded, like those of dogs. Such are some of their chief external characteristics; but, in order to understand their full differences from the civet tribe it is necessary to say something with regard to their teeth. Existing hyænas have a total of thirty-four teeth, of which $\frac{3}{4}$ are incisors, $\frac{1}{4}$ canines, $\frac{1}{4}$ premolars, and $\frac{1}{4}$ molars on each side of the jaws. There is thus only one tooth, and that of small size, behind the flesh tooth in the upper jaw, while in the lower jaw the flesh tooth forms the last of the series.

Here, therefore, we have an important difference from the civets—with the single exception of the fousa, which is otherwise well distinguished—most of these having two molar teeth behind the upper flesh tooth, and all having one molar behind the lower flesh tooth. This, however, is not all, for, whereas the civet family, always excepting the fousa, have

only two lobes to the blade of the upper flesh tooth, in the hyænas the same tooth has a three-lobed blade like that of the cats. Then, again, the lower flesh tooth is also quite unlike that of a civet, and closely resembles that of a cat, the only well-marked difference being the presence of a larger or smaller heel, or ledge, at the

hind end, although in two of the living species it has also an additional cusp on the inner side of the cutting blade.

This curious resemblance of the flesh teeth of the hyænas to those of the cats, it may be remarked, appears to be an instance of what naturalists call *parallelism* in development; that is to say, the resemblance has been acquired independently in the two families, since it is certain that cats are not descended from hyænas, while it is even more obvious that hyænas are not the descendants of cats. This resemblance of the teeth of the



THE AARD WOLF

hyænas to those of the cats, however, is confined to the flesh teeth for in place of having only two premolar teeth in each jaw in front of the flesh tooth, hyænas have three pairs of these teeth in both the upper and the lower jaw between the flesh tooth and the canine tooth. Moreover, these premolar teeth, in place of being much compressed from side to side, like those of cats, have nearly conical and very tall crowns. These strong conical premolar teeth, which are strengthened by small fore-and-aft tubercles at the base, form crushing instruments of immense power; and it is due to these teeth, aided by the flesh teeth and the tusks, that a hyæna is able to crunch in its jaws the shinbone of an ox almost as readily as a dog can break that of a fowl.

THE STRIPED HYÆNA

The striped hyæna (*Hyæna striata*), the only representative of the genus found in India, is one of the two smaller and less powerful species, the length of the head and body measuring $3\frac{1}{2}$ feet, and that of the tail 1 foot 6 inches. The species is characterised by its large and pointed ears, by a crest or mane of long hairs running along the middle of the neck and back, and by the long hair clothing the tail, as well as by

the relatively small size of the hind, as compared with the fore feet. In colour the striped hyæna is some shade of dirty grey, with narrow transverse brown or blackish stripes on the body and legs (page 314). It is found throughout India, where it is especially common in the North-West and Central Provinces, but is unknown in Ceylon. From India its range extends westwards through Baluchistan into Persia and Mesopotamia as far as the Caucasus. It is also common in Palestine, Syria, and Arabia; and from Syria it extends into Northern and Eastern Africa, where it is occasionally met with in Tunis and Abyssinia, but appears to be more common in Egypt.

The East African representative of the species is *Hyæna striata schillingsi*, distinguished, among other features, by its somewhat lighter colour, while the North African *H. s. suilla* is characterised by the great length of its hair and certain details of colour and marking.

During and before the age of the mammoth, striped hyænas wandered over a considerable part of Europe, their remains having been discovered in a cave in the south of France, while teeth have also been obtained in England. They appear, however, to have been far less common in Europe than the spotted species.

Both in India and Syria the striped hyæna frequents open hilly or sandy districts; although in the former country it is occasionally met with in forests, while in the latter it may be found both in deserts and in woods. Like the other species, it is nocturnal, although a stray individual may be seen in the daytime, more especially in the early morning or late in the evening; but the striped hyæna differs from the spotted species in being a comparatively solitary animal, so that it is rare to meet with more than two together. The striped hyæna is a much more silent animal, and the cries of the two species, though similar in some respects, are very different. In Syria and Palestine the favourite haunts of the striped hyæna are the rock-cut tombs; but in India it is usually found in holes and caves in rocks.

The striped hyæna's food consists mainly of carrion or carcases killed by other animals; and in inhabited districts the animal is much dreaded on account of its grave-robbing propensities. Portions of such carcases as it finds are eaten on the spot, while other parts are dragged off to its den, the situation of which is generally indicated by the fragments of bones around the entrance. These hyænas will also feast on skeletons that have been picked to the bone by jackals and vultures; the bone-cracking power of the hyæna's jaws rendering such relics acceptable, if not favourite, food. The striped hyæna will not infrequently carry off sheep and goats as well as dogs. Dr. Blanford states that he has never known instances of larger prey being taken, and supports this statement by mentioning that the live animals tied up so often as baits for tigers and leopards are never molested by hyænas, which are in the constant habit of banqueting on carcases of animals killed by those cats.

THE BROWN HYÆNA

The brown hyæna (*Hyæna brunnea*) is far less well known than either of the other living species. In all respects it is very nearly allied to the striped hyæna, although it exhibits a few points of affinity with the spotted species. It is specially characterised by the long mantle of coarse hair depending from the neck and back and reaching below the belly; the ears are long and pointed, and the tail is short and bushy. The general colour of the long hair is uniform dark brown, with lighter brown or whitish patches on the legs, while the head is dark greyish brown, and the forehead black, sprinkled with whitish or reddish brown. The long hair of the back is whitish grey at the root, and blackish brown above. The legs are striped. In size this species is about the same as the striped hyæna. The brown hyæna is a South African species, and the name of strand wolf is locally applied to it. It ranges on the east coast some distance northwards of Kilimanjaro, while on the west side it may extend as far north as Mossamedes. It does not seem to be found at any great distance from the coast.

THE SPOTTED HYÆNA

The African spotted hyæna (*Hyæna crocuta*) is much the largest and most powerful of the three living species, differing from the others not only in several structural features, but also in its habit of associating in packs, and of giving utterance more frequently to its unearthly cry. Externally, the spotted hyæna is distinguished by its rounded and moderate-sized ears, by the absence of a crest of long hairs along the neck and back, and the shorter and less hairy tail. The hind feet are relatively larger in proportion to the fore feet, and the front and hind legs are more nearly equal in length; the hind limbs being less bent than in the other species. The ground-colour of the fur of the body is yellowish, and upon it are dark brown spots; the front of the face and the lower portions of the

limbs being also dark. In addition to certain structural features of the soft parts, the spotted hyæna is also distinguished by the characters of its teeth. The upper molar tooth, situated on the inner side of the exceedingly elongated flesh tooth, has a very small and nearly circular crown, and is inserted only by a single root, whereas the corresponding tooth of the striped species has two distinct roots. In the lower flesh tooth the posterior heel is small, and the cusp on the inner side of the blade absent. Owing to



THE STRIPED HYÆNA

the disproportion in the length of the hind and fore legs being much less than in the striped hyæna, the gait of the spotted hyæna is less ungainly and awkward in appearance.

The spotted hyæna, of which several local races, mainly distinguished by colour, are now recognised, occurs throughout Africa south of the Sahara, ranging on the eastern side of the continent into Abyssinia and Nubia. At one time it was very abundant in Cape Colony, and Sir Samuel Baker bears testimony as to its numbers on the Upper Nile in the neighbourhood of

Kassala, while Sir H. H. Johnston attests its common occurrence on the plains around Kilimanjaro. Formerly the geographical range of this hyæna was far more extensive than at present, as is proved by the vast quantities of its remains found in the caves of various parts of Europe, from Gibraltar in the south to Yorkshire in the north.

It used at one time to be considered, indeed, that the so-called "cave hyæna" indicated a distinct species from the living one; but naturalists now regard the two as specifically identical, although the fossil European hyænas were generally of larger dimensions than the existing African races. A single lower flesh tooth obtained from a cavern in Madras indicates that the range of this species at one time also embraced the southern part of India.

The spotted hyæna is a much fiercer and more aggressive animal than his Indian relative. During the Abyssinian campaign Dr. Blanford states that these animals constantly came amongst the tents at night, and at times attacked the mules, ponies, cattle, and goats tethered near the camp.

In that part of the country these hyænas are stated to be as common in the highlands as in the lowlands; although this does not appear to be the case in the Kilimanjaro district, where Sir H. H. Johnston observes that they steal sheep and calves from the herds, carry off children, and often attack wounded and weakly men.

EXTINCT HYÆNAS

The occurrence of fossil remains of the spotted and striped hyænas in the cavern and other superficial deposits of Europe has been already mentioned. In the antecedent Pliocene period there was a number of hyænas belonging to species now extinct, some of these being nearly allied to the existing forms, while others differed markedly in the number and characters of their teeth. These extinct hyænas are found over the greater part of Europe—from France to Italy, Greece, and Hungary—and also in Persia, India, and China.

Colvin's hyæna (*H. colvini*), from India, and the thick-jawed hyæna (*H. robusta*) of Greece were nearly allied to the spotted species, while the Pikermi hyæna (*H. eximia*) differed from all living species in having four premolar teeth in the lower jaw. The Siwalik hyæna of Northern India and the Grecian hyæna (*H. græca*) were allied to the striped species, but both have an additional molar behind the lower flesh tooth, while the former has four lower premolars. Again, the long-jawed hyæna (*H. leptorhyncha*), from Northern India, and a nearly allied species from Greece differ from existing forms in their long jaws and the compressed form of the premolar teeth, of which there were four in the lower jaw.

The two last-mentioned species make a marked approach to the civets; but this is still more evident in a smaller extinct hyæna from Europe, referred to a distinct genus under the name of *Palhyæna*. In this animal there were four premolar and two molar

teeth in each jaw, so that the total number of teeth was forty, or the same as in the true civets, and this extinct species was so nearly allied to the extinct *Ichtherium* that the families of civets and of hyænas may be regarded as passing one into the other.

R. LYDEKKER

STORIES OF HYÆNAS

The search for the striped hyæna in East Africa long proved barren, because men sought for it in the wrong half of the twenty-four hours. The striped hyæna is almost exclusively nocturnal; it is faithful

to the words of the Psalmist: "The sun ariseth and they get them away together, and lay them down in their dens." At night all cats are grey, and to the ordinary eye all East African hyænas spotted. But the flash-light camera working at midnight discloses actual facts. In a work on natural history published in 1899, it was definitely stated that the striped hyæna is confined, in Africa, to Somaliland. Thereafter Herr Schillings set his traps and caught six-score striped

hyænas in East Africa, and photographed at midnight many more. Yet, though he sojourned four times in Africa—some seven years in all—only once did he see a striped hyæna by daylight.

The cowardice of the hyæna makes us forget its enormous strength. A naturalist has declared the three most powerful things in animate nature to be the blow of a whale's tail, the stroke of a lion's paw, and the kick of a giraffe's hind leg. We might add a fourth, assigning the place to the hyæna on the score of the power of its bite. Its immense strength is not restricted to biting. An adult spotted hyæna can carry off a full-sized ass, and one of Herr Schillings's photographs shows one in the act. Böhm once saw a hyæna steal a human corpse and make off with it, a feat worthy of a lion. To carry these tremendous jaws, the hyæna has a neck of incredible strength, with muscles so powerful as at times to make the vertebræ almost immovable, so that to the uninitiated the animal has seemed to possess a neck of only one joint.

Other times, other climates. Until Dean Buckland broke into Kirkdale Cave, no one dreamed that an animal now found only in tropical lands had ever inhabited the temperate acres of Old England. Yet in this cave were the bones and teeth of twenty-three different animals long extinct in Britain, among them the tiger, bear, wolf, elephant, rhinoceros, and hippopotamus. In digging out material for road-repairing, the workmen thought they had stumbled upon the remains of cattle which had been victims of a recent murrain. The dean knew better. A skull, which he identified as that of a young hyæna, gave him his first clue. He had discovered an old-time den of hyænas which had here made their headquarters within five-and-twenty miles of the site of the city of York.

Bones of the elephant, rhinoceros, and cave bear, an animal as big as a horse, were strewn over the floor, even to the smallest recesses of the cave. All the bones



THE BROWN HYÆNA

were broken and splintered, and bore marks which exactly fitted the canine teeth of the existing hyæna. The solution was clear to the alert mind of the dean: the bones were the remains of prehistoric animals which had been dragged, piecemeal in many instances, by the hyænas to their lair. Hyæna bones were broken and marked like the rest, showing that hyæna ate hyæna even at that remote period.

In order to make sure, the dean sought for a young hyæna, that he might compare its skull with that he had found. Accordingly, one was brought from the Cape, but on the voyage it had become such a pet that it was decided that it must serve science alive, while another skull was procured elsewhere. The living hyæna proved a valuable aid to knowledge. In the presence of Sir Humphry Davy and other savants, he cracked shins of beef at Oxford University with perfect grace and dexterity, so that Buckland was able to record: "He has performed admirably on shins of beef, leaving precisely those parts which are left at Kirkdale, and devouring what are wanting, and leaving splinters and scanty marks of his teeth on the residuary fragments which are not distinguished from those in the den."

After vast labour and close observation, the dean at length completed the evidence for the former existence of the hyæna in England.

The hyæna brought to England to try his 'prentice teeth on prime shinbones became one of the "lions" of the hour, which was only right and proper, seeing that he was, perhaps, the first hyæna to tread English soil since the days when his ancestors had made merry with the mammoths' bones in Yorkshire and the South. He lived a quarter of a century in captivity in London, and was known as the "tiger wolf." His tameness made him a general favourite, and, the day of the animal tamer not having dawned, it was deemed wonderful that a man should venture into his cage. What would our fathers have said if they had heard that another man, who captured a couple of these animals in Africa, and lodged them in a collection, could, long afterwards, never approach their den without instant and friendly recognition? That man is Herr Schillings, who said that two he brought home to Germany would go to him even when feeding; that they preferred to receive a caress from him even to the delight of a good beef bone. This is a remarkable testimony, for the hyæna has almost the worst reputation of any animal on earth.

Popular legend often pays too high a tribute to the courage of the hyæna. Attack a waking and hearty man who is up and stirring he will not, unless he be cornered, when he will fly at his assailant. This was known in Abyssinia so far back as James Bruce's days. Hyænas were then the curse of the land, as they are

to-day, though, for the sake of the scavenging which they perform, they are not merely tolerated, but encouraged. Bruce declared that they seemed to surpass even the sheep in number. From evening till dawn the town of Gondar, where he was staying, was full of them. Many a time in the night, when the king had kept him late, and he had to cross the square from the royal house, he was apprehensive lest they should attack him. They "grunted" in great numbers around him, although he was surrounded by several armed men. He had an adventure with one in his tent. He heard it moving gently near his bed, and on obtaining a light from his servant, found a hyæna with two or three large bundles of candles in its mouth. Not daring to fire lest he should damage any of his instruments, Bruce aimed a blow at the animal with a pike. "It was not until I had done this that he showed any signs of fierceness; but, upon feeling his wound, he dropped the candles and endeavoured to run up the shaft of the spear to arrive at me, so that I was obliged to draw a pistol from my girdle and shoot him."

Now, as then, the hyænas of Abyssinia cause great destruction among the flocks, but holes are left in the town walls through which they creep, to clear up the refuse of the city. The inhabitants deposit the household refuse at their doors and retire to bed, knowing that not a vestige will remain in the morning. The four-footed scavengers, however, do not scavenge sufficiently well to prevent recurrent epidemics, and at

Harar, as a consequence of the system, the last attack of cholera swept off the men like flies. At Harar, the hyæna is the supreme master of sanitation, and the curious spectacle may be witnessed of these brutes quarrelling over offal outside the building which contains a latter-day marvel—the telephone!

The man who can place a thick wall between himself and the hyænas to which he commits his scavenging may rest in peace, though the hideous outcries of the animals do not conduce to slumber. Where camping-outs unavoidable, special precautions must be

taken to guard against these creatures. Lieut.-Col. Paterson at Tsavo found innumerable hyænas among the raiders of his flocks, but they did not attempt human life. Mr. H. L. Duff, in his book on Nyasaland, however, tells a different tale.

Cowardly as it is, the hyæna is greatly feared by the natives, he says, owing to its habit of sneaking up to them as they lie asleep, and biting their faces. Mr. Duff was assured in Northern Angoniland that the hyænas would often lie in wait outside the huts at dawn, and make a sudden rush at the inmates directly they put their heads out of doors. Strange as this may sound, it is intelligible to anybody who has seen a native hut, the entrance to which is so low that a man is obliged to bend almost on his hands and knees to pass in or out.



THE SPOTTED HYÆNA

THE DOG TRIBE

UNDER the title of dogs are included all the animals known as wolves, jackals, foxes, and wild dogs, along with the various breeds of domesticated dogs. These collectively constitute the family *Canidæ*, and form a group in some respects intermediate between the cats, civets, and hyænas, on the one side, and the bears, raccoons, and weasels, on the other. The dog family always has an especial interest, since it includes the animals which have become more thoroughly the friends and companions of man than any other creatures. The origin of domesticated dogs, however, to a great extent is shrouded in the mist of antiquity, and it is still in some degree an open question whether the various breeds are descended from a single wild stock or are the product of several species.

The dog family forms a compact and well-defined group, the wild members of which cannot be confused with those of any other. All are characterised by long and pointed muzzles, moderately long tails, and perfectly digitigrade feet, furnished with blunt, nearly straight, and non-retractile claws. Then, again, all dogs have only four toes on the hind feet, while, with the exception of the African hunting-dog, the number of toes on the fore feet is five, of which the first, or innermost, is shorter than any of the others, and does not touch the ground. The limbs, although varying in relative length, are never so short in proportion to the body as is the case in so many members of the civet family. The ears are pointed and erect, but vary greatly in length in the different groups.

In all dogs the skull is characterised by its elongated muzzle and the large number of teeth with which it is furnished; in both of which respects it is widely different from the skull of the cats. On the under surface of the hind part of the skull the tympanic bulla is inflated and bladder-like, although not divided into two chambers by a complete partition. This part of the skull serves, therefore, to distinguish the dogs from the Carnivora mentioned above, with the exception of the hyænas.

From hyænas, as well as from cats, dogs are readily separated by the number and structure of their teeth. With but few exceptions, the total number of the teeth is forty-two, the series consisting of $\frac{3}{4}$ incisors, $\frac{1}{2}$ canines, $\frac{1}{4}$ premolars; and $\frac{3}{4}$ molars. The excess in the number of the teeth of a dog over those of a civet is owing to the presence of an additional pair of molars in the lower jaw. This will not, however, serve to distinguish between all dogs and the civets, since the Asiatic wild dogs, or dholes, have only two pairs of lower molars. In all cases there are four premolar teeth on each side of both jaws. The cheek teeth of dogs are constructed on the same general plan as those of the civets, the upper flesh tooth having but two lobes to the blade, while the lower flesh tooth has a large heel behind the cutting blade; this heel being, however, relatively smaller than in the civets. In both dogs and civets the molars of the upper jaw have the same general triangular form.

In uniformity of structure and outward appearance, dogs differ widely from civets, and more nearly resemble cats. There is a considerable amount of difference in external appearance between a fox and a wolf, but

intermediate forms connect them so closely that they may be considered as members of a single genus.

On the other hand three members of the family differ so remarkably from all the rest, and also from one another, that they are regarded as the representatives of as many genera. Some diversity of opinion exists as to the advisability of also referring the Asiatic wild dogs to a distinct genus, but they are here classed in the typical genus *Canis*. According to this scheme, the whole of the existing members of the family are ranged under four genera, two of which are severally represented by a single species (pages 353-4).



A WOLF FROM SIBERIA

With the marked exception of the African hunting-dog, most of the members of the family are characterised by their more or less uniform and often sombre colouring, in which respect they are strikingly different from both the civets and the cats. The colouring of dogs varies from grey to yellowish or reddish brown; the upper part of the head and back, as well as some portions of the limbs, being generally darker than the flanks, while the under parts are paler. The outer surfaces of the ears may be distinctively coloured, and there is often a dark mark between the eye and the nose, and another near the tail; but, as a rule, transverse stripes or patches differing in hue from the

ground-colour of the fur are absent or ill-defined.

Some species, like the South American maned wolf and the fox, have the colouring more or less bright chestnut; while the black-backed African jackal takes its name from the broad band of black running along the back, and other African species show a dark flank stripe. In spite, however, of the frequent uniformity of colouring, many of the species are subject to a remarkable amount of either local or seasonal variation, in respect both of colour and length of the fur. In consequence of such variations and the conflicting opinions among naturalists as to the amount of difference necessary to constitute a species, a satisfactory decision on this matter is difficult. Some naturalists, for instance, consider the large wolves and the red foxes of North America specifically distinct from their European and Asiatic relatives, while others regard the former merely as local races of the latter. In these circumstances no attempt is made in this work to estimate the number of living species of this family.

As regards the seasonal variation in the colouring, it may be observed that the hue of the fur is generally lighter in winter than in summer; this difference attaining its maximum in the Arctic fox, of which the winter coat in one race is pure white. Among species or races inhabiting high altitudes or mountains, the fur is longer in winter than in summer. Moreover, as in the cats, some species show more or less marked tendencies to the development of black examples. Again, and especially among foxes, the colour of different individuals or races of a single species may vary from a greyish, through a yellowish, to a reddish tinge; while, if the general colour remains the same, there may be darker or lighter shades. Added to these variations in the colour and length of the fur, there may also be a large amount of difference in point of size in the same species.

Most, if, indeed, not all, members of the *Canidæ* have a gland situated near the base of the upper surface

of the tail, the position of which is usually indicated by a darker patch of hair. Foxes have also glands beneath the tail which secrete the strong scent for which these animals are famous.

A peculiar characteristic of many members of the dog family, and one in which they differ from cats, is their habit of associating in large packs for the purpose of hunting their prey. Such prey is pursued chiefly or entirely by the aid of smell, which attains an extraordinary development in some members of the group. This keen perception of scent, however, is not accompanied by any deficiencies in the sense of sight and hearing, both of which are highly developed. It is probably due to this habit of associating in packs that many of the dogs are, to a greater or smaller extent, diurnal; although the majority are also, at least in part, nocturnal. Hunting by sight, as in the case of greyhounds, is probably an acquired feature due to domestication.

From the nature of their claws, no dogs are fitted for climbing trees; and none is especially adapted for an aquatic life, although several of the domesticated breeds are excellent swimmers. The cry of the various species of the wild members of the family varies greatly, but may generally be termed a howl rather than a bark, although some utter a kind of yelping bark. Apparently all the species can be tamed to a certain degree, although the extent to which this taming can be carried out varies in different species, and even in different individuals of the same species.

All wild dogs are in the habit of living in burrows, in the clefts of rocks, in caverns, or in hollow trees. Some species, like the fox, excavate burrows for themselves, while others take advantage of the deserted holes of other animals; and whereas some species dig solitary burrows, others excavate them close together, so as to form a colony, or warren. The number of young in a litter is stated to vary from three to as many as a dozen, and it is believed that in all cases the cubs or "pups" are born blind. Several of the wild species, like the jackal and the wolf, will freely interbreed, and the hybrid offspring between either of these species and domesticated dogs are known to be fertile.

As regards geographical distribution, the dogs are more widely spread than any family of Carnivora yet noticed, and in this respect are only approached by the weasel family. This wide distribution is the more remarkable when the uniformity in the organisation and external appearance of the members of the group is taken into consideration. The great majority of species is to be found in the Northern hemisphere, where two are common to Europe and North America. A single species, the dingo, is now found wild in Australia, where, however, it was almost certainly introduced by man; but no wild member of the family occurs in either Ceylon or Madagascar.

In disposition and in the nature of their food many of the *Canidæ* display marked differences. The European wolf, for instance, which hunts in packs, and is exceedingly fierce, will attack both human beings and cattle, but the solitary South American maned wolf is a timid and comparatively harmless animal, except to the small creatures upon which it preys. Again, whereas the majority of species are more or less purely carnivorous, and kill their own prey, jackals live largely upon carrion; while other species devour lizards, mice, and even snails and insects. Others will eat marine molluscs and crustaceans, while the Arctic fox subsists largely upon fish, as does the domesticated Eskimo dog.

THE WOLF

If we exclude some of the breeds of domesticated dogs, the wolf (*Canis lupus*) is the largest living member of the family (page 365). It belongs to a group which includes the other wolves, the jackals, and the domesticated dogs, and all the wild species are characterised by their powerful teeth, the moderate brush formed by the tail—in which the hair is longer than that of the body—and by the pupil of the eye being round. Moreover, in the skull of all these animals the bony projection forming the hinder border of the socket of the eye is regularly curved downwards and has a convex upper surface; whereas in a fox the same process is hollow above, and has a more or less marked tendency to curve upwards behind.

With the exception of the Antarctic wolf of the Falkland Islands, true wolves are restricted to the Northern



THE WOLF

hemisphere, being unknown both in Africa and South America. The typical European wolf measures about 3½ feet in length, exclusive of the tail, and is characterised by having a woolly under fur of a slaty brown colour. The prevailing hue of the fur is typically of a rufous or yellowish grey above, which may be more or less mingled with black; while the under parts are whitish. The tail, which is considerably less than half the length of the head and body, may be tipped with black. From this ordinary type of colouring there may be variations, owing to the development of a more or less marked grey or red tinge; while in some cases the fur may be much paler than usual, and in others nearly or quite black. In Europe the light-coloured varieties appear to be characteristic of northern, and the dark of southern, regions, black or blackish wolves being not uncommon in Spain.

Of the various local forms of the wolf, the Tibetan race (*Canis lupus laniger*) is characterised by the length and woolliness of the fur, which is frequently black. The Japanese race (*C. l. hodophylax*), on the other hand, is smaller than the typical wolf of Europe, with proportionately shorter limbs and tail, and a longer muzzle. North America possesses two types of large wolves, which, although frequently regarded as representing

THE WOLF

species by themselves may be classed as local races of the common wolf.

The American grey wolf (*C. l. occidentalis*) varies in colour from uniform white through the various shades of grey to black; most specimens being grey and white more or less tinged with brown. Its range includes western North America, from Greenland to Mexico, as far south as Idaho and Nebraska. The northern, or so-called grey, phase of this wolf is nearly white while in Texas a reddish hue prevails.

Some writers recognise a second American race, the so-called timber wolf (*C. l. nubilus*), ranging from the Great Slave Lake to the longitude of Idaho, and southwards to Nebraska and probably California, and chiefly characterised by its sooty or leaden brown colour and comparatively short tail. The name timber wolf is given to distinguish these animals from the prairie wolf, or coyote. The wolf of Arctic America is frequently or invariably white, with a black tail-tip, and many constitute a distinct race of the species.

Largest of all is the huge Alaskan wolf, in which the length from the muzzle to the tip of the tail may be 5 feet 10 inches, and the height at the shoulder, 31½ inches. Dr. D. G. Elliot has described this monster wolf as a distinct species under the name of *Canis pambasileus*. According to this description, the Alaskan wolf is nearly allied to the timber wolf of western North America, but of larger dimensions, and displays certain distinctive differences in the form of the skull and lower jaw. It is on these skull differences that Dr. Elliot chiefly relies in separating the wolf of Alaska from the timber wolf.

Many examples are all black, with only a few white hairs showing here and there, and in some districts this seems to be the typical form of the animal. From this sable hue there is, however, a transition to specimens in which the predominant tint is brown relieved by jet black lines on the head and neck. The tail in animals of the latter type is mostly white, but mingled in places with black, and with a black tip. Viewing the Alaskan wolf as a variety of the ordinary wolf rather than a distinct species, its proper title will be *C. l. pambasileus*.

A specimen of this wolf presented by Mr. Selous to the British Museum has the ears, limbs, and most of the tail black, but elsewhere there is an admixture of tawny with the black, and the under parts are whitish. The head is of such dimensions as to recall a bear rather than a wolf; and the power of the creature must be enormous. Messrs. Stone and Cram, who recognise only one race in the United States, observe that it is practically the same as the wolf of Europe.

In Spain, Dr. A. Cabrera recognises two races of the wolf, the first of which (*C. l. signatus*) is still common in many parts of Central Spain, and is closely allied to the typical wolf of Scandinavia. It is, however, distinguished by a white area on the cheek, which joins the white of the throat, and the redder tawny colour of the upper parts generally. In the northern wolf the white area on the cheek is represented by a pale patch, quite isolated from the white of the throat.

The second race (*C. l. deitanus*) is much smaller than an ordinary wolf, with a distinctly jackal-like appearance and a less brilliant type of colouring. Its most important characteristic is that the under parts, with the exception of the groin, are a rufous tawny instead of white, while the upper parts are greyish tawny mingled with black. The height of the typical specimen is 22½ inches, against 26 inches or more in the ordinary wolf. The habitat of this wolf is the district between the Sierras de Taibilla and de las Cabras in South-Eastern Spain.

In "The Field" for 1905 Mr. J. G. Haggard gave a description of a so-called wild dog from Malaga, which was described as yellowish grey, with an inter-mixture of grey hairs, the tail inclining to be bushy, the ears like those of a fox, and the under parts dirty white. As Mr. Haggard's description accords fairly well with the

one given by Dr. Cabrera, there seems little doubt that the two animals are identical. Possibly the wolf of South-Eastern Spain is the Spanish representative of the Egyptian *Canis lupaster* and the Indian *C. pallipes*.

The southern limit of the wolf in America is the State of Guana-juato, in Mexico.

Including all the varieties mentioned above under a single specific title, the range of the wolf is very extensive, embracing the whole of Europe, the greater part of Asia northward of the Himalaya and as far east as Japan, and nearly all North America.

In Europe the wolf has disappeared from Britain and Central and Northern Germany, but still lives in the wilder or more mountainous districts of the rest of the Continent, being especially abundant in many parts of Russia.

Wolves were formerly abundant in the British Islands; in Yorkshire they were common in the reign of Richard II.; while in the time of Cromwell parts of Ireland were much infested by them. In England the wolf became extinct during the reign of Henry VII.; it survived in Scotland until 1743; and the last was killed in Ireland, according to Richardson, in 1770, or, according to Sir J. E. Tennent, after 1766.

Wolves inhabit both open country and forests, and although generally found in pairs or solitary, at times, and more especially in the winter, associate in large numbers. They wander abroad in the daytime and at night. Although usually cowardly, stealing their prey by night, wolves become bolder and more daring when driven by hunger or when hunting together. The lair of the wolf is formed in a rocky cavern, or within the hollow of a fallen trunk, or beneath the roots of an overthrown tree, or more rarely in holes in the ground; such burrows being sometimes dug by the animal itself. A dense thicket will also not infrequently serve as a hiding-place. In these lairs the cubs are born, the number in a litter generally varying from six to ten. The cubs, which are born in the spring,



THE TIMBER WOLF

remain with their parents till the end of November or December, but may sometimes continue with them for a much longer period.

The ordinary cry of the wolf is a loud and prolonged howl. The amount of noise that a single wolf can produce is astonishing. More than one lone American traveller has hastily taken to a tree, and remained in the inhospitable shelter of its branches all night, believing himself surrounded by a pack of at least fifty fierce and hungry wolves, when in reality there was but one, which may have been on the further side of a lake, a couple of miles away. By association with domesticated dogs, wolves soon learn to bark. They will breed freely with the larger kinds of domesticated dogs, and some of the Indians in the northern States of America are said to improve the breed of the sleighing dogs by crossing with the wolf. The endurance of the wolf's gallop is proverbial, and the animal displays remarkable caution in avoiding all kinds of traps, and when caught will frequently feign death in the hope of being able to escape.

Fossil remains of the wolf occur in the caverns and superficial deposits of England and the Continent, the earliest horizon from which they have been obtained in England being the so-called Forest Bed of the eastern coast, which antedates the Glacial period.

R. LYDEKKER

STORIES OF WOLVES

Though the same love of strange pets which induces some to keep young tigers and leopards also leads others to attempt the domestication of the wolf, they cannot eradicate the instinct of their *protégé*. Sooner or later ill befalls the owner or his friends. One naturalist has a couple of wolves in England with which he is on the best of terms, but another patron of animal outcasts befriended a wolf which rewarded him by biting a piece out of a visitor's cheek. Most folk are, therefore, satisfied to observe the wolf from the right side of the dens of some zoological gardens. They are best studied when excited at the prospect of food. As they leap ten or a dozen feet up the side of their den, and then land again noiselessly on their feet, we may agree with an admiring observer that they put even the suppleness of the great cats to shame.

There are many different estimates of the speed of a wolf. The action is deceptive. The long, elastic gallop does not suggest the speed which it represents. A man mounted on a fast pony tried to cut off a timber wolf which was crossing an open plain in the daylight, and rode for a point it would have to pass. The wolf did not hasten its speed, but took a wider *détour* before reaching the point where the hunter expected to meet it; and there it was, without apparent extra effort, three hundred yards to the good.

Sir Montagu Gerard had an experience in India which differed from the opinion of Colonel Percy that "a wolf in the evening, when empty, will lope along just ahead of two good greyhounds till the latter lie down exhausted."

The wolf in question loped ahead of Sir Montagu's three good greyhounds, but it was not the hounds which lay down exhausted; the wolf was bayed in a shallow pool. The dogs were fresh enough, but they would not enter the water, nor would the wolf leave it. At the outset one of the pursuers had been a large cross-bred bull-terrier, which was rapidly left behind in the race. But with the wolf thus bayed, it presently ran up, entered the water, and sat down to blow, within a couple of yards of its antagonist. As soon as it had regained its wind, the bull-terrier seized the wolf by the throat, and killed it by half-throttling, half-drowning the beast.

On another occasion the same authority set a couple of powerful deerhounds, crossed by Polygar dogs, at a brace of wolves. The dogs overhauled their quarry, but, following them into a jungle, were lost to view. They presently emerged, one with a bad gash in the neck, and both satisfied to let the wolves escape.

Many are the instances in which solitary wolves have attacked human beings; but it is in winter, when they work in packs, that they are most to be feared. Hunger-maddened, they will even enter towns in the countries plagued by their presence. There was a very tragic encounter between some men and a pack of these beasts close to the railway station of Sihlea, in Moldavia. One January night, as a party of seven carol-singers were returning home, a wolf-pack dashed upon them. The young men, who carried nothing but light staves, were powerless to resist the onslaught, but they fought as men struggling for life will fight. Four of them however, fell dead, and were pounced upon and nearly devoured while the other three men continued, greatly enfeebled, to battle on. When they, too, were almost overcome, a train arrived, and the passengers were just in time to save the lives of the three survivors, who, though badly mauled, were still on their feet.

There is a grim story of an experience of Miss Marsden, the missionary to the Siberian lepers. Travelling by road at night on her errand of mercy, she observed on both sides of the forest a number of lights, which she took to be gleams from cottage windows. She suggested to her driver that they should halt at one of the cottages, but the man informed her that the lights were not from windows, but were the eyes of wolves.

Was there ever a wolf-reared child? Does Rome honour the species in vain, and is that wolf which she keeps caged alive in distinction year by year thus exalted without cause? Lord Wolseley does not think so. When in the neighbourhood of Sultanpur, he writes in his "Story of a Soldier's Life," he heard many accounts "of babies having been stolen by wolves, and reared by them. I had previously read of this in Sir William Sleeman's interesting book on Oudh, so I assume it was a well-authenticated fact. If so, the legend handed down to us by the Conscript Fathers about Romulus and Remus, which many have ridiculed for twenty-six centuries, may well have been true at a



WHITE PHASE OF THE WOLF

THE CUBEROU

time when wolves flourished in the valley of the Tiber." The idea receives support from Sir Montagu Gerard. The native idea is, he says, that the cubs, not being hungry when the child is brought in, begin to play with the child instead of devouring it, and so it becomes an adopted member of the family. E.A.B.

THE INDIAN WOLF

The Indian wolf (*Canis pallipes*) is distinguished from the ordinary wolf by its smaller size and lighter build, as well as by its shorter fur, which has little or no woolly under-fur. The length is about three feet, exclusive of the tail; and the general colour of the fur greyish tawny, usually with a brownish tinge, and sometimes with more or less black on the back. In character the animal is more of a jackal than a wolf, and its skull agrees closely with that of the larger African jackal (*C. lupaster*), although the teeth are larger and stouter.

The Indian wolf, which is confined in India south of the Himalaya, is rare in Lower Bengal, and unknown on the Malabar coast, and appears to be replaced by the common species to the west of the Indus, which may indeed range into some of the cis-Indus districts. The young are born in holes or caves among rocks during October, November, and December, the number in a litter varying from three to eight. In habits the Indian wolf is very similar to the common species, but although somewhat gregarious, does not associate in large packs, six to twelve being the largest number that have been seen together. Moreover, it is a rather silent animal, rarely, if ever, howling like the common wolf, but sometimes barking like a pariah dog. Its food includes such mammals and birds as it can kill, but sheep, goats, and antelopes appear to be the chief favourites. On occasion these wolves will attack adult human beings, for which purpose two or more will combine; and in certain districts a large number of children are annually carried off from the villages.

THE COYOTE

A second somewhat jackal-like species, of which there are numerous local races, is the coyote, or prairie wolf (*Canis latrans*), of North America. This animal is considerably smaller than the common wolf, from which it is also distinguished by its thicker and longer fur and more bushy tail. On account of this greater length of fur, the coyote appears to be a thicker-built and shorter-legged animal than is really the case. The colour varies locally and at different seasons of the year, being bright tawny brown in summer and grey or greyish in winter; this ground-colour at both seasons being overlain with a shading of black, which tends to form stripes along the back and across the shoulders and loins. The under parts are of a dirty white tint, while the upper portion of the muzzle and the out-sides of the ears and legs are generally tawny.

The coyote, which ranges from the south of Costa Rica, in Central America, to the lower portions of Hudson Bay, is still abundant in Texas and Northern Mexico, but is rare in Guatemala. Not improbably it is only a comparatively recent immigrant into Central America.

The coyote is more generally in the habit of burrowing in the ground than is the wolf; it is also far less savage and destructive, and becomes more docile and more gentle in captivity. Like the wolf, it will on occasions hunt in packs, and it is at least as noisy an animal, although the tone of its howl is quite different.

As regards food, the coyote is almost omnivorous, and, when animal diet is unattainable, will feed upon juniper berries or the prickly pear. Hares, rats, young birds, and so forth, form, however, its staple diet; and it never attacks the larger mammals, although, when wounded and brought to bay, it will defend itself fiercely. In speed it is far inferior to the wolf, and can be readily overtaken by a good horse. The cubs are born in May and June, the number in a litter usually being five or six, but occasionally ten.

THE ANTARCTIC WOLF

Seeing that no true wolf is found in continental South America, it is strange to meet with a small species, apparently nearly allied to the coyote, inhabiting the Falkland Islands. The Antarctic wolf (*Canis antarcticus*) is rather smaller than the larger examples of the coyote, and has shorter fur and a less bushy tail. The general colour is yellowish mingled with black, the individual hairs being yellow at the base,

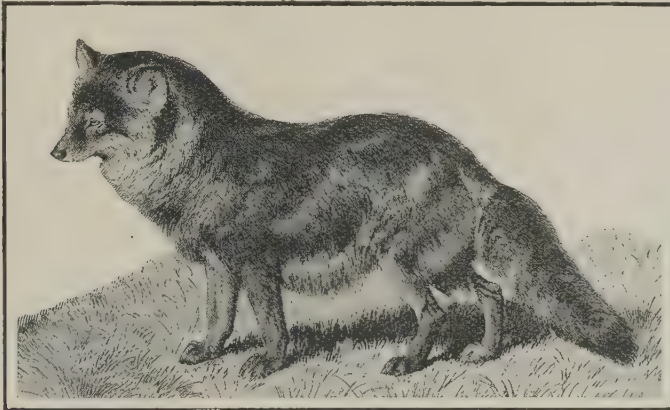
with black tips; the fur of the under parts is whitish. White is also the colour of the fur on the lips, chin, and throat, as well as on the inner margins of the ears. The most characteristic colouring, however, is that of the tail, in which the first two-fifths are of the same hue as the body, the next two-fifths black, and the remainder white.

The Antarctic wolf was discovered by Perety during his voyage in 1763 and 1764, and Darwin, who saw them

during the voyage of the Beagle, writes, "As far as I am aware, there is no other instance in any part of the world of so small a mass of broken land, distant from a continent, possessing so large an aboriginal quadruped peculiar to itself." These wolves did not associate in packs, were largely diurnal, and usually silent, except during the breeding season; they burrow in the ground, and prey on geese and penguins. This interesting species is now apparently extinct, and unfortunately only a small number of specimens are preserved in the museums of Europe.

THE CUBEROU

A specially interesting species is the cuberou, or so-called Abyssinian wolf (*Canis simensis*), which takes its specific name from the mountains of Simien, and, although of about the same size as the coyote, is not really a wolf, but rather a kind of overgrown fox. The skull is distinguished by its great length and slenderness, and presents the fox-like character, that the upper surface of the projection behind the socket of the eye—technically known as the postorbital process—is concave instead of convex. The teeth are very small in proportion to the size of the skull, thus confirming the opinion that the animal is a large fox, in which the size of the body, and notably that of the jaws, has



THE COYOTE

increased, without any corresponding enlargement of the teeth, which are far smaller than in the true wolves.

The cuberou has an extremely long and narrow snout, larger ears than wolves, and a thick, bushy tail like that of a jackal. Its general colour is light reddish brown with a tinge of yellow; the mouth, chest, under parts, and the front of the upper portions of the legs being whitish. The greater part of the upper surface of the tail is mottled with black, and its tip is wholly black. In habits this animal is stated to be fox-like.

THE JACKALS

The jackal of Asia (*C. aureus*) is the typical representative of a group of *Canidae* the members of which are

of smaller size than the true wolves, with which, however, they are to some extent connected by the Indian wolf and the coyote (p. 314). All the members of the group are confined to the warmer

regions of the Old World, and in all of them the bushy tail is relatively shorter than in the wolves, being equal to about one-third the length of the head and body; and the skull may be distinguished by the smaller size of the flesh teeth as compared with the molar teeth behind them.

The common Asiatic jackal is subject to considerable variation in point of size, the length of the head and body varying from 2 to 2½ feet. Its general colour ranges from pale isabelline to pale rufous, with a larger or smaller admixture of black on the upper parts. The under parts are paler, and the muzzle, ears, and the outer sides of the limbs more rufous than the rest. The reddish brown hairs of the tail have long black tips, thus forming a distinct black tip to the tail.

The largest member of the group is the Egyptian jackal (*Canis lupaster*), which stands some 16 inches in shoulder height, with a total length of about 50 inches. Stoutly built, with proportionately short ears, this species has the upper parts yellowish grey mingled with black, which tends to collect in streaks and spots. The muzzle, the backs of the ears, and the outer surfaces of both limbs are reddish yellow, the margins of the mouth are white, and the terminal half of the tail is darker than the back, with a black tip.

The Morocco jackal (*C. anthus*) of North-Western Africa is a smaller, paler-coloured, sharper-nosed, and more lightly built animal than the Egyptian species.

A third species is the variegated jackal (*C. variegatus*) of Abyssinia and Somaliland, which, although standing about 15 inches at the shoulder, and therefore little inferior in this respect to the Egyptian species, is smaller and lighter in general build, its total length being only 40 inches. Compared with the Egyptian jackal, which has more the shape of a wolf, the Morocco species is more greyhound-like in form, its height being due to its great length of limb. The ears are rather larger than in the Egyptian jackal, and the

body colour is pale stone buff with blotches of black. Somaliland is the home of a pigmy jackal (*C. mensesi*), standing only about 12 inches in height, and characterised by its greyish yellow body colour, mingled with only a small proportion of black; the muzzle and legs being more decidedly yellow and the under parts white.

The handsomest member of the whole group is the black-backed, or silver-backed, jackal (*C. mesomelas*). This species appears almost as though its back was covered with a black saddle-cloth, the contrast between this sable, silver-spangled area and the bright rufous tan of the flanks and limbs being very striking. The blackness in this species is concentrated on the back, the black on the fore legs of other jackals being absent. The large ears and the sharp, slender muzzle confer on the black-backed jackal a somewhat fox-like appearance.

The remaining African representative of the group is the side-striped jackal (*C. adustus* or *C. lateralis*), so named on account of the presence on each side of the body of a white and a black stripe, of which the latter represents the margin of the dark area in the black-backed species. Although greyish drab, with a mixture

of black, is the prevalent colour, there is a tendency to rusty red on the fore and hind limbs; and the rather long tail, unlike that of the black-backed jackal, has a black tip. The skull and teeth are relatively small and weak, the former approximating to that of the fox in its flattened upper surface. The range of the side-striped jackal extends from Zululand to Uganda and the Gabun.

The Asiatic jackal ranges from the south-eastern countries of Europe to India and Ceylon, thence it extends through Assam to

Northern Pegu and the neighbourhood of Mandalay, although it is much less common east of the Bay of Bengal than in India. In the Himalaya it ascends to from three to four thousand

feet above the sea-level. Throughout India it may be found indifferently in hilly or flat country, in forest or open districts, or in large cities. Although jackals are frequently in the habit of going singly or in pairs, they often associate in packs, which may be of considerable size, these assemblages being more common at night than during the daytime.

In India the jackal is a more nocturnal animal than the wolf, but its wanderings are by no means confined to the night; while in winter jackals may be seen abroad at all hours of the day. In extremely hot weather they appear to suffer from the heat, and may be found either lying in the water, where they spend most of the day, or sneaking away therefrom, instead of being, as usual, hidden in their holes. Their food comprises not only carrion and the flesh of such animals as they are able to kill, but also fruit, maize, and sugarcane. In the towns and villages of India jackals act



ASIATIC JACKAL



EGYPTIAN JACKAL



MOROCCO JACKAL

THE JACKALS

as efficient scavengers. Occasionally they take to killing poultry and lambs or kids, and weakly goats and sheep often become their prey, while wounded antelopes are tracked down and killed. Among vegetable foods, the chief favourite seems to be the so-called ber-fruit, but in certain districts jackals do enormous damage to sugar plantations, biting ten or a dozen canes for one they eat. Like the civet in Java, jackals in the Wynad district of Madras feed on the ripe fruit of the coffee plant.

In the jackal of Eastern Europe and Asia Minor, which agrees in general character with the Indian species, the colour is pale dirty yellow, more or less tinged with rufous, with a variable amount of black on the back. In the Morea, where these animals are very common, they are asserted to be in the habit of disinterring dead bodies from the graveyards. The cry of a pack of jackals, when heard for the first time, strikes the ear with a peculiarly blood-curdling chill, and gives the impression that it is uttered by a much larger number than is really the case. Dr. Blanford has described the cry as consisting of two parts—first, "a long wailing howl, three or four times repeated, each note a little higher than the preceding, and then usually a succession of three quick yelps, also repeated two or three times. The common Anglo-Indian version of 'Dead Hindu, where, where, where,' gives some idea of the call." In the variegated jackal of the Abyssinian highlands the second half of the cry is omitted.

Occasionally the skull of the Asiatic jackal has a peculiar bony process growing from the upper part of the occiput, which is said to be covered during life by a horny sheath, concealed among the hair, forming the so-called "jackal's horn." The female jackal generally gives birth to her young in a hole in the ground, although they have been found in an old drain, the number of cubs in a litter being usually from three to five. The pariah dogs of India breed freely with the jackal. Fossil remains of jackals occur in the Siwalik Hills of Northern India.

The black-backed jackal in Abyssinia does not occur at such high elevations as the variegated species. The northerly limit of this jackal is Middle Nubia, whence its ranges extend along the east coast of Africa to the Cape, although there are many places in this tract of country where it is apparently absent. In South Africa it extends across the continent, and up the western side as far as Mossamedes, but appears to be unknown in the Congo territory. This jackal occurs both in the open country and in bush jungle.

In the sandy regions on the shores of the Red Sea this species is to be found in the small thickets covering the banks of ravines, which swarm with hares and pangolins, upon which the jackal feeds. At night it visits the villages of the natives, and, in Somaliland, it is stated to bite off the fat tails of the sheep. In the Sudan it lives chiefly upon the smaller antelopes, and mice, jerboas, and other rodents. In South Africa the fur of the black-backed jackal is much esteemed by natives, and is used for making their cloaks or carosses.

In inhabited districts on the west coast of Africa the side-striped jackal frequently enters the native villages, where it interbreeds with domesticated dogs. Its cry, which may be heard night and morning at all seasons of the year, is fully as long-drawn and appalling as that of the Asiatic jackal. Dr. Pechuel-Loesche states that these jackals can be tamed with facility,

and that when in the Loango district he had several young specimens, one of which attained maturity.

They were extremely playful, and would run after and catch almost any animals they saw, including beetles, grasshoppers, birds, and small mammals. They would readily eat almost anything that was offered them, such as bread, beans, rice, fish, flesh, bananas, and oil-palm nuts. One of these tame jackals would answer to its name, Mbulu, and was remarkable for the cleanliness of its habits, being particularly averse from getting its feet wetted by rain, seeking during showers the shelter of the huts. Ordinarily it did not sit down on its haunches after the manner of a dog, but lay at full length, with its nose between its fore paws, generally selecting a sunny spot, where it rested blinking in the sunlight.

R. LYDEKKER

STORIES OF JACKALS

"The Belly That Runs On Four Feet" is the title which the jackal receives in Rudyard Kipling's story, in which the animal has the adjutant and the Mugger



BLACK-BACKED JACKALS

of Mugger-Ghaut for companions. His timidity and guile are well established in the story, but he is credited with a tolerance of hunger which no jackal out of the "Jungle Book" ever achieves. Still, we must forgive the touch of unreality in which a starving jackal lies down to sleep when a village near by holds promise of provender. Had not the jackal stayed, we should have missed the man who, as a five-year-old "Mutiny baby," was almost snatched to death by the terrible crocodile.

Nevertheless, the jackal does not willingly let appetite overcome discretion; with no belt to tighten, it can lie low and wait, not for something to turn up, but for the disappearance of the cause which frightens it from its food. Thus, he will not immediately attack freshly killed game if the carcass be covered with boughs and grass. The jackal suspects a trap and will watch for hours, until satisfied that the covering hides no menace to itself.

That, however, is not to be taken as a wholesale condemnation of the jackal's intelligence. It has skill enough to keep itself going from age to age without perceptible diminution of numbers. Indeed, it is believed that the advent of the big-game hunter in the wilds is advantageous, for a time at least, to the

jackal. With its extraordinary power of scent, it follows up the game which the sportsman leaves in his wake, and enjoys a much more generous diet than was possible when it had to depend upon the lion as paramount provider. The greater beasts go, but the jackal flourishes. In India, at all events, it succeeds to the seats of the mighty. When the gloom of night settles down upon ruined cities that once teemed with human life and splendour, the jackal steals forth, from the tomb, it may be, of the man who once ruled supreme at that very spot. Mayhap the satrap's name and history are forgotten; the descendants of the people he governed are far-scattered, but the jackal is there now as the jackal was there then, excepting that to-day it is more likely than not that it has the place to itself.

The jackal is always cited as an example of the skill of wild animals in executing concerted plans for



THE SIDE-STRIPED JACKAL.

the attack and capture of prey. Sir J. Emerson Tennent describes how at nightfall a pack of jackals, after watching a hare or small deer taking refuge, immediately surrounded it on all sides. "Having stationed a few to watch the path by which the game entered, the leader commences the attack by raising the cry peculiar to their race, a cry resembling the sound, 'okkay,' loudly and rapidly repeated. The whole party then rush into the jungle and drive out the victim, which generally falls into the ambush laid to entrap it."

From the same authority comes the assurance that when the jackal has brought down and killed its game, its first impulse is to hide it in the nearest jungle, whence it issues with an air of easy indifference to observe whether anything more powerful than itself may be at hand, which might, perchance, despoil it of its booty. If the coast is clear it will return to the concealed carcass, and carry it away, followed by its companions. But if a man be in sight, the jackal has been known to seize a cocoa-nut husk in its mouth, or any similar substance, and fly at full speed, as if eager to carry off its pretended prize, returning for the real plunder at some more convenient season.

The jackal has been likened to a dog lacking the arts and graces due to domestication. One incident in an Abyssinian setting was reminiscent of the domesticated dog. A traveller was minded to shoot jackals, and called to his huntsman to guide him to the quarry. The native strode off to a likely spot, and waited. Presently a jackal appeared. It was beyond the range of the gun, and the Englishman expected to have to stalk. Not so the native. He calmly whistled, and the jackal turned at the sound and advanced, as if expecting some tit-bit. The Englishman could not bring himself to kill so trustful a creature. We are not to suppose that, had the jackal caught the sportsman napping, it would have been as considerate; the honours of the adventure were with the man.

Seeing that the jackal in its wild state is so little afraid of man, the captive jackal is equally amenable to reason. The other year, three black-backed jackals escaped from their den at the Manchester "Zoo," and traversing the whole length of the gardens, sneaked out on to the highway by the ordinary exit. They were found playing on the road by boys, who essayed to shepherd them back. One they headed off so successfully that it fled. The other two trotted back through the gateway by which they had come, and calmly returned to their den, unmolested and unassisted. The other was afterwards caught without much difficulty, and restored to the companionship of its fellow truants.

E. A. B.

THE DINGO

Were it not for the fact that Australia has so few native mammals other than marsupials, the dingo (*Canis dingo*) might have been regarded as an aboriginal inhabitant of the country where it is found, in which case it would rank as a natural species. The improbability of the island-continent, however, possessing a native placental mammal of such large size as the dingo is so great as to induce the belief that the animal was introduced by man, and hence that it originated from some of the domesticated dogs of Asia. This presumed introduction must have taken place at so early a date that there has been considerable hesitation among some naturalists in admitting such an origin. The fact that a half-wild dingo-like dog is found in Java supports the opinion that the dingo reached Australia along with the ancestors of the present native inhabitants, from South-Eastern Asia, and that it is allied to the Indian pariah dog. If this be so, the proper name of the dingo is *C. familiaris dingo*.

The dingo is an animal of smaller size than a wolf, with moderately tall legs, a long and somewhat bushy tail, a broad and short muzzle, and well-developed ears. In regard to colour, it varies from red to black. There is a greyish under-fur, but, except in the black variety, the long hairs are yellow or whitish. The top of the head and dorsal region are of a darker reddish yellow, often intermixed with black; while the under parts are paler, and may be whitish. The end of the tail is often nearly white, as are frequently the feet, and sometimes the muzzle, though this may also be black. The animal may be of a uniformly light reddish or yellowish brown, except that it is paler beneath, on the outside of the fore legs, below the elbow, as well as on the inner side of the limbs and on the cheeks.

THE DINGO

The dingo is found in wooded districts throughout Australia, and in many such situations is extremely numerous; but the Government reward for its destruction has led to a considerable diminution in its numbers. It is a terrible foe to sheep, killing and mangling a far greater number than it eats, and it is equally destructive to poultry. On account of these depredations, the colonists wage a war of extermination against it.

In its mode of life and habits the dingo has been compared to the fox rather than the wolf. It is shy and retiring, rarely seen during the daytime, and pursuing its work of devastation in the night. It is seldom found in large numbers together, parties of from five to six—a mother and her cubs—being the most common. Occasionally, however, troops of from eighty to one hundred have been seen. Each family is stated to have a strictly defined area, beyond which its members do not venture, and into which those of other families do not intrude, this being a trait common to the pariah dogs of Egypt. The young, as a rule, are born in the hollow of a trunk of a tree, and vary from six to eight in a litter. Naturally, dingoes never bark, although, like wolves, they easily learn to do so from association with other dogs. When caught, they are usually in the habit of shamming death. The dingo breeds freely with the various European dogs introduced by the colonists.

In regard to their domestication by the Australian natives, Dr. Lumholtz states that on the Herbert River there are rarely more than one or two dingoes in each tribe, and ordinarily they are of pure blood. The natives find them as puppies, and rear them with greater care than they bestow on their children.

Fossil remains of the dingo are found in certain of the superficial and cavern deposits of Australia, in association with those of a number of extinct species more or less closely allied to the marsupials still inhabiting the country; and the introduction of the dingo is thus carried back to the Pleistocene division of the Tertiary period. In some, at least, of the deposits in which its remains occur there is also, I believe, evidence of the contemporary presence of man; and if in all the deposits in which dingo bones occur there were also indications of human presence, the introduction of the animal by human agency would present no difficulty.

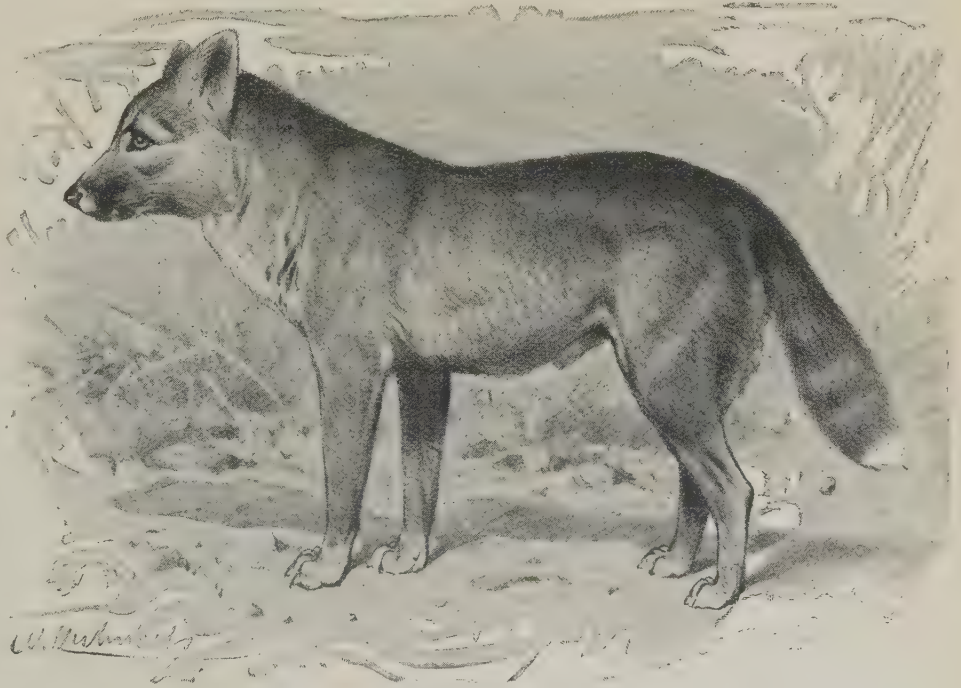
DOMESTICATED DOGS

Although many different views have been, and are still, entertained with regard to the mutual relationship and origin of the various breeds of domesticated dogs, most naturalists are agreed that in the first instance all, or at least most of them, were derived either from wolves or jackals, or from both together. Whether,

however, the origin has been a single one—that is to say, whether all domesticated dogs were derived from one particular species of wolf or from a single species of jackal—or whether they are a product of the crossing of two or more distinct races, independently derived from as many wild stocks, or whether some breeds are derived from particular wild species without any subsequent crossing, are questions still undecided.

That domesticated dogs trace their origin to wolves or jackals, or both together, and not to foxes, is evident from the structure of their skulls; and that the domesticated breeds are not descended from the dholes, or wild dogs of Asia, is evident from the latter having one molar tooth less in the lower jaw than is the case with the other members of the genus. Additional testimony that foxes have nothing to do with the origin of domesticated dogs is afforded by the fact that hybrids between the fox and the dog, notwithstanding numerous specimens of supposed hybrids of this sort which are from time to time brought to notice, are of extreme rarity, if not altogether unknown.

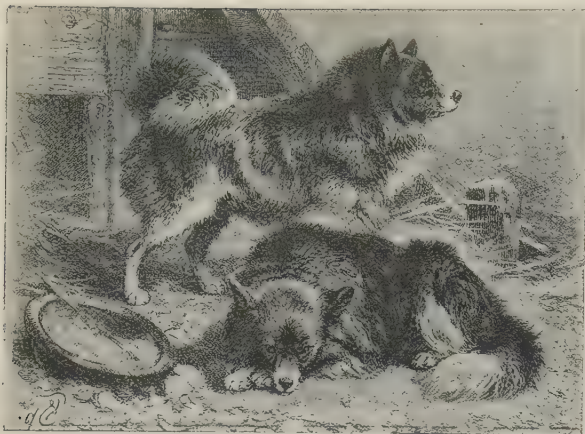
The different breeds of domesticated dogs present variations far greater, both as regards size and form, than those between any wild members of the canine family. Great as these differences undoubtedly are, they are to some extent paralleled among the various breeds of domesticated pigeons and fowls, the former of which are definitely known to have originated from a single wild stock. But, since dogs of very different breeds freely cross with one another, and the resulting



THE DINGO

progeny is perfectly fertile, there can be no difficulty in regarding all the domesticated races as now constituting a single species.

The main argument in favour of the view of the multiple origin of the dog is that the different early and original breeds of the domesticated dogs of different countries approximate in appearance to the wild species of the same regions. For instance, Eskimo dogs are exceedingly like wolves, and it has been confidently stated that we are justified in regarding them as nothing more



POMERANIAN DOGS

than reclaimed wolves. Indeed, the Eskimo are said to be in the habit of crossing their dogs with wolves, in order to maintain their size and stamina. Then, again, some of the more northerly tribes of the Indians of North America have wolf-like dogs whose howls are so like those of wolves that even their owners can scarcely distinguish between the two. On the other hand, the domesticated dogs of the Hare Indians closely resemble the coyote, which is the most common species in the districts inhabited by those tribes.

The black wolf-dog of Florida is almost indistinguishable from the black variety of the wolf characterising that country; and many of the sheep-dogs and wolf-dogs of Europe resemble the wolves inhabiting the same districts; while the marked resemblance of some of the pariah dogs of India to the wolf of the same country is well known. Moreover, in South-Eastern Europe and Southern Asia many of the domesticated dogs so closely resemble jackals that it is sometimes difficult to distinguish between them. Still more important is the fact that some of the domesticated dogs of South Africa present a striking resemblance in form and colour to the black-backed jackal, although they have lost the distinct black back characteristic of the latter. Equally noteworthy is the resemblance between certain South American domesticated dogs and the wild Azara's dog of the same regions.

With the extraordinary diversity existing among the different breeds of dogs, it is impossible to give any general characteristic by which they can be collectively distinguished from wild species, with the exception of the habit of barking, which is common to most, although not all, of the former, and is unknown, naturally, in the latter. This characteristic will, however, distinguish other domesticated breeds from the Eskimo dog, and also from the dingo. Very generally domesticated dogs have the habit of carrying the tail curled over the back, and thus markedly differ from the manner in which the straight "brush" of a wolf or jackal is borne.

Then, again, the acquisition by some domesticated breeds of drooping ears is a decided difference from all their wild relatives; while an equally well-marked characteristic of many domesticated breeds is the distribution of more or less brilliant colours in patches, in which respect they are widely different from their wild ancestors.

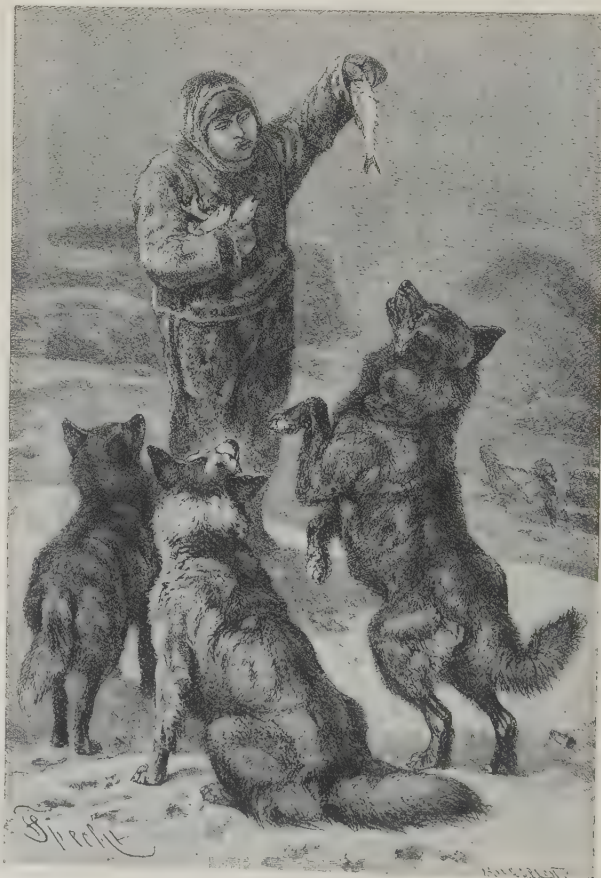
From deposits in Russia belonging to the Polished Stone age Dr. T. Studer has described the skeleton of a large dog closely allied to the domesticated species. This dog, *Canis pontiatini*, is believed to have been originally wild, but afterwards domesticated by early man. In general characters it comes very close to the

dingo. By crossing between this species and the wolf, Dr. Studer believes that other extinct species or races of dogs have arisen, and from these in turn have been developed mastiffs, on the one hand, and deer-hounds, on the other; and it is also presumed that the sheep-dogs and hounds trace their origin directly to the same ancestral form. On the other hand, terriers and Pomeranians are believed to have sprung from a totally different extinct stock. It has, however, still to be proved that *Canis pontiatini* is a truly wild form, and not a domesticated derivative from the wolf.

Domesticated dogs—the varieties of which have been estimated at no fewer than 185—may be grouped in the following main divisions, namely: (1) Wolf-like dogs; (2) greyhounds; (3) spaniels; (4) hounds; (5) mastiffs; and (6) terriers. By intercrossing between various members of these different groups all the existing breeds may have been produced.

ESKIMO AND ALLIED BREEDS

One of the most wolf-like of all the domesticated breeds is the Eskimo dog of Arctic America. With their small, upright ears, long and bushy tails, moderately sharp muzzles, and rough coats, as well as in their general build, so closely indeed do these dogs resemble wolves that a pack of them has at least on one occasion been actually mistaken for wolves. These affinities are further indicated by this dog's inability to bark. The Eskimo dog is represented by allied breeds in Northern Asia, of which the Samoyede of Eastern Siberia is one of the best known. Eskimo dogs, however, are very generally black and white, while Samoyede dogs are more often wholly white.



ESKIMO DOGS

ESKIMO DOGS

Dr. F. H. H. Guillemard gives the following account of the habits of these dogs, which have been so valuable to Arctic explorers: "The only food they are provided with by their masters is salmon of the hump-backed kind; but during the summer they pick up game, eggs, and birds in their wanderings about the country. They are usually inspanned in teams of eight or ten, but where the sledges are heavy or the roads bad, double that number, or even more, are occasionally used. When the snow is hard and even, they will draw a weight of 360 pounds a distance of five-and-thirty or forty miles with ease in a day's work; and with an unloaded sledge, with a single occupant, a pace of eight versts an hour can be kept up for a considerable time. On the road they are given one-third of a fish twice during the day, and a fish and a half at night, which they wash down with a few gulps of snow.

"Each has a name, to which he answers when he is driven in the sledge, just in the same way as a Cape ox in a waggon team, for no whips are used. If chastisement be necessary, the driver throws his stick at the delinquent, or pounds the unfortunate creature with any stone that comes handy. There are many ways of tethering these animals, all having in view the one object of keeping them apart, as, excepting upon the road, they seize every opportunity of fighting. One method is by making a large tripod of poles, and tying a dog at the bottom of each; and in many villages, owing to the large number of dogs which have to be kept, these tripods form a characteristic feature."

The Hare Indian dog is found only in the region of the Great Bear Lake and the Mackenzie River, and is used for hunting purposes by the Hare and certain other Indian tribes. Sir John Richardson states that it has a mild countenance, with at times an expression of demureness, "a small head, slender muzzle, erect, thickish ears, somewhat oblique eyes, rather slender legs, and a broad, hairy tail, which it usually carries curled over its right hip. It is covered with long hair, particularly about the shoulders; and at the roots of the hair, both on the body and tail, there is thick wool. The hair on the top of the head is long, and on the posterior part of the cheeks it is not only long, but, being directed backwards, it gives the animal, when the fur is in prime order, the appearance of having a ruff round the neck. Its face, muzzle, belly, and legs are of a pure white colour, and there is a white central line passing over the crown of the head and the occiput. The tail is bushy, white beneath and at the tip. The feet are covered with hairs, which almost conceal the claws." This dog, although of a playful and affectionate disposition, is not very docile, and is impatient of all kinds of restraint. Its voice is very like that of the coyote, but when for the first time it sees any new and startling object it attempts a kind of bark.

Under the title of Pomeranians are included a large and a small breed. The Pomeranian may be regarded

as one of the nearest allies of the Eskimo, and is a middle-sized or small dog of strong build, with a sharply pointed muzzle, upright and pointed ears, and a thick, bushy tail generally carried curled over the back. The fur is long and coarse, and varies from black, through grey, yellowish, and foxy red, to pure white; the darker varieties usually having a lighter patch on the forehead, and also white marks on the feet.

The larger Pomeranian was formerly used as a wolf-dog, and should properly be of a pale fawn-colour, without any admixture of white, and with



CHINESE DOGS, OR "CHOW-CHOWS"

black "points." The smaller Pomeranian, or spitz, as this breed is often called, has the disadvantage of being somewhat uncertain in temper; it is employed as a sheep-dog in its native country, and is then most esteemed when entirely black. There is, however, on the Continent an almost complete transition from the pure black to the white spitz, which was the one most commonly met with in England till the black breed came into fashion. A well-bred white spitz ought to have a black tip to the nose, and in all cases the ears should be perfectly upright, without any tendency to fall over at the tips. The heavily furred curly tail is generally carried on the left side of the body. The fur on the throat forms a thick frill or ruff, and there is a considerable amount of long hair on the fore legs. The face has very short hair.

Originally used as a watch-dog on barges in the Belgian canals, the Schipperke has now become a well-established breed in England, and is notable on account of its intelligence and good nature. These small black dogs, of which there are two sizes, are nearly related to, although easily distinguished from, the spitz; but the absence or shortness of the tail is due to docking, although it is stated that tailless puppies are occasionally born. The weight should be 12 pounds

in the smaller and 20 pounds in the larger breed. Nearly resembling the Pomeranian in appearance is the Chinese dog, or "chow-chow," the general colour of which is typically reddish, with a mixture of dark brown hairs in the fur of the back, which gives it a somewhat speckled look, but a black breed is also common.

SHEEP-DOG AND COLLIES

The sheep-dog and its ally the Scottish collie depart more from the wolf-like type than the species hitherto noticed in having the tips of the ears pendent. The old English sheep-dog has a sharp muzzle, medium-sized head, with small and piercing eyes, and a well-shaped body, formed after the model of a strong, low greyhound, but clothed in long and somewhat thick and woolly hair, particularly strong about the neck and chest. The tail, which is always cut, is naturally strong and bushy. In almost all sheep-dogs there is a double dew-claw on each hind leg, very often without any bony attachment. The legs and feet are strong and well formed, and stand road-work well, and the untiring nature of this dog is very remarkable. The colour varies greatly, but is mostly grey or black or brown, with more or less white. Many of the sheep-dogs used in England, however, have been crossed with other breeds, and thus depart more or less widely from the original type.

A handsomer animal than the English sheep-dog is the Scottish collie, which has the same mental characters, but differs considerably in external form and colouring. This dog has the same sharp muzzle as its English cousin, but a rather broader head, with a slight fall to the tips of the small ears. The build of the body is rather light and elegant; and the hair with which it is clothed is long and woolly, and stands out evenly on all sides so as to form an efficient protection from the extremes of climate to which these dogs are exposed in their native hills. The ruff on the neck is more developed than in the sheep-dog, and, indeed, than in any other breed. The tail is very bushy and carried with the tip elevated, so as to keep its long hairs free from the ground. In pure-bred specimens there is a thick under-fur beneath the long hairs, and the hind legs should be free from any fringe of hair, although the fore legs may have a little fringe.

The colour may be either black and tan, or either of these tints alone, with a larger or smaller admixture of white. The black is seldom very intense in tone, and the tan has no tinge of the mahogany-red of the setter. The collie has been introduced into England as a pet dog, and is often crossed with the black and tan setter, so as to produce a breed which differs from the original form—notably in the silky hair, without under-fur, and the long fringes on both fore and hind legs. In some parts of the Scottish Highlands and in the north of England, there is a smaller and more slender variety known as the smooth collie, characterised by the smooth coat of short and stiff hairs, which are generally of a mottled grey colour, more or less mixed

with white, but may be black and tan, or even tan and white.

All the breeds of sheep-dogs display their affinity to the wolf in their elongated and narrow skulls, with very long muzzles, the profile of the face alone displaying a slight degree of concavity. The premolar teeth are separated from one another by distinct intervals; and there is no tendency for the lower incisor teeth to project beyond the line of the upper jaw.

The drover's dog, which varies in different districts of England, is generally a cross between a sheep-dog and some other breed. The size of these dogs is very variable; and both this character and the form are modified by breeders according to the special needs of the districts for which the animals are required. Drovers' dogs generally have their tails cut short. Their duty is to conduct flocks and herds from one locality to another, and they are remarkably adept in separating the members of the herd under their own charge from those of any other herd which they may meet during their journey.

PARIAH DOGS

Considerable interest attaches to the more or less nondescript dogs found in troops in the towns and

villages of Eastern Europe, Asia, and Africa, and commonly designated pariah dogs, on account of the marked resemblance presented by some of them to the Australian dingo. These dogs vary greatly in different districts, but many present a very wolfish appearance, and it is probable that they sometimes interbreed with wolves and jackals, while in India they may also cross with wild dogs. Originally, however, these pariah dogs were domesticated breeds which, from neglect, have reverted to a

greater or less extent towards a wild state. The pariah dogs of Egypt appear to belong to a single breed, and are of about the size of a sheep-dog, but of stouter build, with broader heads; the tail being long and generally bushy, and carried close to the ground. The colour of their coarse, rough hair is reddish brown, tending in some cases to grey, and in others to yellow. Occasionally black or tawny may be observed. Their ears are short, pointed, and usually erect.

These dogs live an independent life, frequenting the rubbish mounds with which the old Egyptian towns and villages are surrounded, and passing the greater part of the day in sleep, while towards evening they wake up and prepare themselves for their nocturnal prowls. Each dog possesses its own particular lair, which is chosen with especial care; and frequently one dog will have two such lairs, one occupied in the morning and the other in the afternoon. When, as is often the case, the mounds in the neighbourhood of Cairo run nearly north and south, so that both sides are equally exposed in winter to the cold north wind, the dogs are careful to excavate a hole facing the south, in which they may gain protection from the cutting blasts. In the morning the dogs will be found in those lairs which have an easterly aspect, so that they may receive the full benefit of the sun's rays; towards



ROUGH-COATED COLLIES

ten or eleven o'clock, however, these quarters become too hot to be pleasant, and the dogs shift to the western side of the mound, where they may continue their sleep. When the sun reaches their lairs on this side, the dogs return to their morning haunts, where they remain till sunset.

Pariah dogs in other countries are very similar in manners to the foregoing, but in Constantinople and most Indian cities they frequent the streets, and are habitually ill-used by the passers-by. In Siam and some other Buddhist countries, however, they are specially protected by the lamas, or priests, and allowed to use the temples as places of refuge; but the food supply of these dogs is of the scantiest, and their appearance is miserable. There is a half-wild breed of pariah-like dogs, the so-called *tengera dog*, in Java.

THE GREYHOUND GROUP

The English greyhound may be regarded as the typical and most specialised representative of the second main group of domesticated dogs, all of which are characterised by their long and narrow muzzles, their slight build, elongated limbs, and small ears, which generally fall at the tips; but they differ greatly in the length of the hair. They are further distinguished by their habit of hunting either entirely or partially by sight, instead of by scent. The long, slender skull of the greyhound points to affinity with the wolf, or some other wild member of the family, and the group is of great antiquity.

The English greyhound is distinguished from all other dogs by its slender form, smooth hair, and rat-like tail, coupled with its comparatively large size. This dog is, indeed, perfectly adapted to extreme speed, the long, slender limbs, with wire-like muscles, giving the utmost possible length of stride, while the smooth coat, sharply pointed head, elongated neck, and thin tail offer the least resistance to the air. The long muzzle and neck are necessary to enable the greyhound to seize a small animal like a hare when running at speed; other noticeable points are the great depth of the chest, which affords ample room for the lungs, and the small size of the abdomen. The attenuated muzzle is of itself sufficient indication that the greyhound cannot hunt solely by scent, as the snout is too small to contain space for the large extent

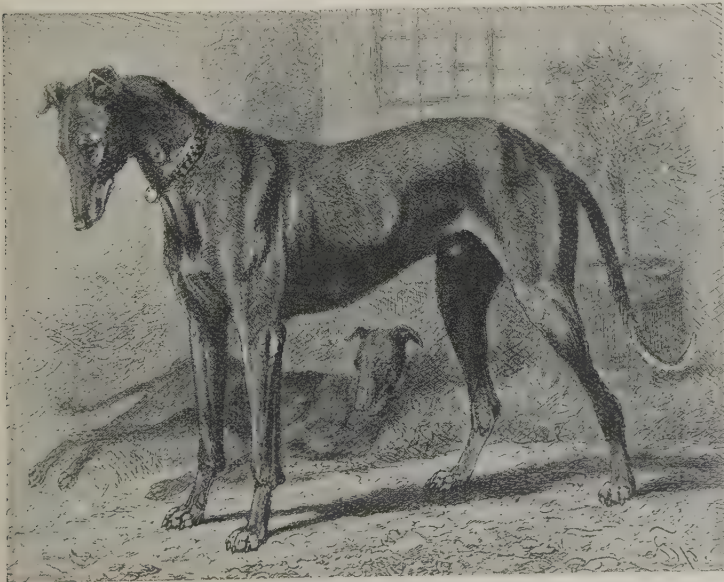


A PARIAH DOG

of surface in the cavity of the nose necessary in dogs that hunt by smell. The short coat of the English breed is probably an acquired character, since most other members of the group are long-haired dogs.

At one period the greyhound became too weak in the jaws to kill its prey, but this defect was remedied by crossing with the bulldog; the bulldog blood being gradually eliminated until the proper combination of strength with speed was attained. The head of the modern breed should be broad and flat between the ears, without that arching characteristic of other breeds. The eyes should be of the same colour as the coat; and the ears always fall at the tips, although there are reports of an old-fashioned breed in which they were erect.

The length of the neck should be approximately equal to that of the head; although it is not very easy to say where the neck ends and the chest begins. Much importance is attached to the formation of the fore quarters of the greyhound, the best strains having the shoulder-blades of great length, obliquely placed, and well clothed with muscle, and likewise the upper portion of the fore leg (humerus) of considerable relative length. Of not less importance is the conformation of the hind limbs, in which the upper and lower portion of the leg should be of great relative length, so that the whole limb should be much bent at their junction.



ENGLISH GREYHOUNDS

The hind limbs must be set rather wide apart at their lower extremities, to allow of their being brought forward with the utmost celerity in running; while in the haunches attention is especially directed to the development of sufficient width. That the foot-pads should be hard and horny, in order to withstand the wear and tear of racing over hard and rough ground, is self-evident, but opinions differ as to the precise form of foot that is most desirable. The tail should be devoid of any fringe of long hairs, and, while thick at the root, should at first taper somewhat rapidly and afterwards more gradually. It should hang close to the hind quarters for the greater part of its length, terminating in an upwardly-inclined curve, which generally forms about three-fourths of a circle. Colour is regarded as of minor importance in determining the "points" of a greyhound. A

uniform colour, such as sandy or slaty grey, however, is preferred to a mixture.

The delicate Italian greyhound may be regarded as a miniature of the English greyhound. Its proportions are most elegant and its speed is considerable, but so delicately is it made that it is incapable of pulling down even a rabbit. The muzzle and tail are relatively somewhat shorter than in the English greyhound, while the eyes are proportionately larger and softer. There are several colours, among which a golden fawn is the most valued; next to this comes a dove-coloured fawn, after which are cream-colour and the so-called blue-

come very close to the original. There were formerly in Ireland two breeds of wolf-dogs, one of which was a greyhound and the other a mastiff, somewhat resembling the great Dane; and it is shown from an old picture that there was also a cross-breed between the greyhound and the mastiff-like dog, in which, however, the characteristics of the latter predominated. Skulls of these dogs have been discovered in various parts of Ireland, which indicate animals of great size and power. Some of these, belonging to the mastiff-like breed, are considerably larger than the skull of a German boarhound which stood $32\frac{1}{2}$ inches at the shoulder.

A very fine and, at the same time, a very ancient breed of greyhound is the slugh (salughi), also known as the Persian or Arabian greyhound, and sometimes as the gazelle-hound. These dogs are found in Arabia, Persia, Syria, and North Africa, but their original home seems to have been the first-named country. The Hon. Florence Amherst states that, according to Arab notion, the following are the essential features of the slugh: "Rather flat feet with slight tufts between the toes, formed to enable them to course over the yielding sand; the tail plumed with a paler shade, and gaily carried when galloping; the dense, smooth coat, with only the exact amount of feathering; the silky ears, which, when pulled down, should reach the corners of the mouth; the strong teeth and deep, 'laughing jaws'; also the varied colour of the eye, with its marvellous human expression, the deep chest, and strong though ever-graceful frame. The narrow part of the back should be spanned by three fingers, not four.

"The height is about 23 inches. The colour of the slugh varies from gold to dust-colour, cream, and white. The Arab choice is said to be guided by the tint of the ground over which the slugh has to hunt, to conceal him from the quarry. The slugh is trained to hunt hares, foxes, jackals, and other desert animals, but it is with the swift gazelle that he is seen to perfection. For this sport he is employed with or without the conjunction of a hawk, his duty being to hold down the quarry till the hunter gallops up, but not to kill and thereby render the game illicit for food according to Mahommedan rules. The hound works wonderfully with the falcon, and in a close country when hunting hares, where he is continually losing sight of the animal, courses entirely by following the flight of the bird." Though the hawk is usually employed, the test of a really good slugh is that he can course gazelle without its aid.

The Grecian greyhound differs from the slugh in the absence of fringes of long hair to the ears, although the tail is well haired; while the Albanian greyhound is stated to be more heavily built, with the hair on the body finer and that on the tail longer and coarser. Nearly allied to these breeds is the Afghan greyhound, in which the colour is reddish fawn and the hair on the ears, flanks, and limbs very long and silky; the ears, as in the foregoing rough-haired breeds, being completely pendent. These dogs are likewise used for gazelle-coursing, and occasionally also, like Persian greyhounds, for hunting the wild ass, this being accomplished by employing relays of dogs.



SLUGH AND AFGHAN GREYHOUNDS

fawn. There are also black, red, yellow, white, and parti-coloured varieties, several of which depend for their value upon the colour of the muzzle. In the uniformly coloured varieties there should not be a single spot of white.

The Scottish deerhound, or rough greyhound, is larger and heavier than the English greyhound, frequently standing as much as 28 inches at the shoulder, while its weight may exceed 80 pounds, that of the English greyhound being seldom above 65 pounds. The body is clothed with a rough and rather shaggy coat of hair, the texture of which varies in different breeds, being sometimes as stiff as in the wire-haired terriers, while in other cases it is of a more silky and more woolly nature. The legs should be devoid of a fringe of hair; while the tail should likewise be comparatively smooth.

The favourite colours in the Scottish deerhound are dark slaty grey, fawn, grizzled, or brindled. White should be absent, although no objection is taken to a small spot on the forehead. When the fawn-coloured variety has the ears tipped with brown it is considered perfect. The Scottish deerhound was at one time employed for deer-stalking and coursing, and this different use has given rise to various strains.

The ancient wolf-dogs of Ireland formerly enjoyed a reputation for great power and strength and for their prowess against wolves. The original breed, or, rather, breeds, however, appear to have completely died out, so that we are acquainted with the original type of these fine dogs mainly by tradition and history. By careful attention to these accounts, and judicious selection, a modern breed has been produced which is believed to

SPANIELS

More distinct is the borzoi, or Russian wolfhound, which has become such a favourite in England as a house-dog. These dogs, which stand from 28 to 31 inches in height, have moderately long, silky coats, with a comparatively short fringe to the tail, the prevalent colour being white, with or without fawn, lemon, grey, brindle, slaty, or black markings, too much black being considered a detriment. In Russia these dogs are used for chasing wolves and coursing hares; they hunt both by sight and scent.

Especial interest attaches to the Ibiza greyhound of the Balearic Islands, in which the build is more compact than in the North African slugh, and the coat is short and thick, although in many specimens the tail is feathered, while the general colour is foxy red, yellowish brown, or isabelline yellow. Red and white examples, however, are not uncommon. The slender head terminates in a long, narrow muzzle, but the most characteristic features are the ears, which are large, spoon-shaped, and upright. In this respect the Ibiza greyhound differs from all other existing members of the group in which the ears are completely or partially pendent. The upright condition of the ears is a proof of the antiquity and primitive character of the Balearic greyhound.

In Minorca a tradition exists that these greyhounds originally came from the Pityusen group, especially Ibiza (Iviza), and this southern origin suggests their original derivation from North Africa. This is confirmed by their resemblance to some of the greyhounds depicted in the ancient Egyptian frescoes in appearance, colour, and habits. It was long a matter of wonder why the old Egyptian painters represented some greyhounds with upright ears, but the Ibiza greyhound indicates that the Pharaonic artists were true to nature, and there seems no doubt that the former is the direct unmodified descendant of the prick-eared greyhounds of the old Egyptian frescoes.

These Pharaonic greyhounds are stated to have been exported to Carthage, whence they probably spread over North-Western Africa.

Here may be mentioned the curious hairless dogs of Central Africa, which closely resemble small greyhounds in appearance. These dogs have long, slender bodies, moderately elongated and thin necks, narrow and pointed muzzles, tall foreheads, long tails and limbs, and no dew-claws on the hind feet. Their ears are pendent at the tips, and, like the body, are devoid of hair; it is only in the neighbourhood of the tail, around the mouth, and on the limbs that there is any hair at all. The skin is generally slaty, with flesh-coloured patches. Other breeds of hairless dogs occur in China, Central and South America, Manila, and the Antilles and Bahamas.

The lurcher is a cross either between the deerhound or rough Scottish greyhound and the collie, or between the English greyhound and the sheep-dog, or any pair of these four. The breed may be roughly designated as a dog with the shape of a greyhound combined with the stouter build, larger ears, and rougher coat of the sheep-dog.

THE SPANIEL GROUP

The field spaniel may be taken as the first representative of the third division of domesticated dogs. These are all characterised by their large pendent ears, comparatively wide heads, with moderate muzzles, relatively short and stout limbs, thick and frequently

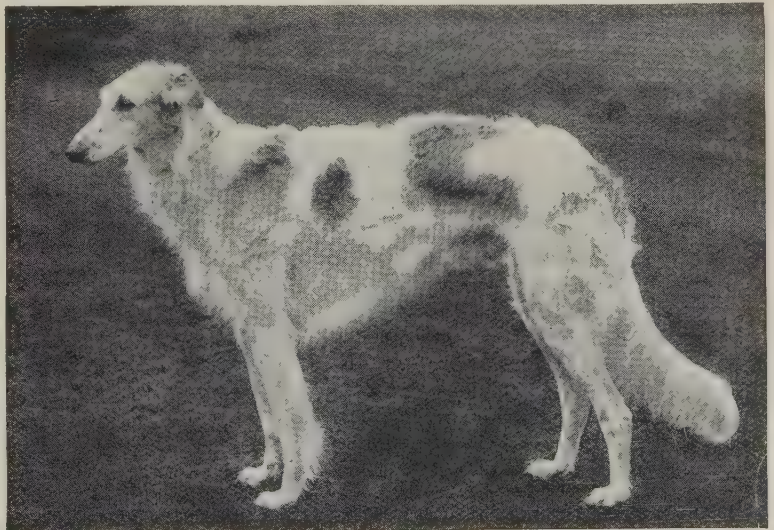
long hair, and thickly haired tails. Their skulls are distinguished from those of all the dogs yet mentioned by their width and comparative shortness, this being especially noticeable in the palate and lower jaw. The profile of the skull is also more markedly concave, the brain-case rising suddenly at the eyes, and thus indicating great mental power.

True spaniels, as their name denotes, are probably of Spanish origin, and are divided into field and water spaniels, in addition to which there are the smaller breeds, kept only as pets. Field spaniels form some of the best shooting dogs, and generally give notice of the proximity of game by their voice. They are divided into the Clumber, Sussex, Norfolk, and cocker breeds.

The Clumber spaniel, which is distinguished by its silence when hunting, is a heavily built dog, of comparatively large size, soon tiring when at work. The head is massive, with a deep furrow along the top, large flesh or liver coloured nostrils, large and generally hazel eyes, and long ears shaped like a vine-leaf, without a very long fringe of hair. In build, the Clumber is long and low, the length of the head and body being two and a half times the height. The hair of the body should be silky and of moderate length, with a slight wave, but no curl; its ground-colour being always white, with yellow or orange spots, the lemon-yellow tint being preferred.

The Sussex spaniel, which has the ordinary lobe-shaped ear and gives tongue when hunting, has a less heavy head than the Clumber, and a wavy coat of a golden liver-colour, without any mixture of white.

The Norfolk spaniel, which is subject to considerable variation, and may be either liver and white or black and white in colour, differs from the two preceding breeds by the lesser proportionate length of the body,



A BORZOI

Photo T. Fall

and the longer fringe of hair on the ears, which frequently nearly touch the ground.

Cockers are small spaniels, divided into Welsh and modern cockers; the former being liver or liver and white; while the latter are larger, and generally completely black. The head is relatively long, the eyes are less full than in the other breeds; and the coat is soft, silky, and waved, with a considerable amount of fringe on the throat and limbs.

King Charles and Blenheim spaniels are much smaller animals, probably derived from the cocker. The King

Charles is typically black and tan, with a larger or smaller mixture of white, and is characterised by the great length of the ears; but in the whole coloured ruby breed the coat is bright golden tan or liver-colour. The colour of the Blenheim is pearly white and bright tan. In both breeds the muzzle is extremely short, with an upturned nose; while the head is nearly globular, and the ears should touch the ground. The coat should be long, silky, and wavy, but devoid of curl, and the ears, limbs, and feet abundantly fringed. Formerly the Blenheim and King Charles had longer noses and were used in sporting.

Pekinese toy dogs, which have become fashionable in England, appear to be members of the spaniel group, and are characterised by their small size, short muzzles, very long silky hair, and long, heavily haired tail, which should be carried curled forward over the right side of the back. Many of these valuable dogs are reddish fawn in colour, but others are black or pale fawn. Japanese spaniels, which are often black and white, are large-bodied and less "lion-shaped."

The water spaniels, of which the best-marked breed is the Irish, are relatively large dogs, with broad, splay feet, and a woolly, thickly matted, and often curly coat of a more or less oily nature. The southern Irish water spaniel is characterised by the bare face and thinly haired tail, the presence of a distinct "top-knot" on the crown of the head, the long curls round the legs, and the thickly curling coat of the body and ears, the colour being of a uniform puce liver tint. The northern variety of the Irish water spaniel has shorter ears, with but little fringe, while the curls of the body hair are shorter and closer, the colour being either liver or liver and white.

The various breeds known as setters are large spaniels which have acquired the habit of standing at their game, and derive their name from having been originally taught to crouch down when marking game, in order to admit of the net with which the quarry was taken being readily drawn over them. With the use of guns, however, this habit became of no advantage, and setters were taught to assume the attitude of pointers. There are five chief breeds of setters, three of which are commonly seen in England.

The English setter, regarded as the result of a cross between the field spaniel and the pointer, should have a silky coat, with a slight wave, but no curl in the hair. Both fore and hind legs should be thinly fringed with

hair, while in the tail the fringe of long hair should fall regularly, like the teeth of a comb, without any signs of bushiness. In the middle of the tail the length of the fringe should be from six to seven inches in length, while at the tip it should not exceed half an inch.

An abundance of hair between the toes is another "point" of the setter. There is great variation in colour, which is valued according to the following scale—namely, black and white ticked with large

splashes, known as the "blue Belton"; orange and white freckled, termed "orange Belton"; orange or lemon and white without ticks; liver and white, ticked; black and white with slight tan markings; black and white; liver and white, without ticks; pure white; black; liver; red; or yellow.

The Irish setter is of a red colour, without any trace of black, and little or no white; but there is one strain characterised by its red and white colour. It is a rather more "leggy" animal than its English cousin, with a narrower and rather longer head,

more produced nose—of which the colour is deep mahogany—and more tapering ears, which, when extended, should reach nearly to the nose.

The Gordon, or black and tan, setter is characterised by its mixture of jet black and mahogany tan colours, although the original breed was black, tan, and white. It is a heavier dog than either the English or Irish breeds, this heaviness being specially shown in the head, which makes some approach to that of the bloodhound.

The nose is relatively wide, and rarely shows the concave profile of the English setter; the tail is rather short; while the coat, although in some strains silky, may be much coarser than in the other breeds.

The Welsh setter, which shows a great amount of variation in colour, is distinguished from the preceding by its curly coat. Finally, the Russian setter is almost entirely concealed by a long woolly coat, which is matted together in the most extraordinary manner.

The name of retriever is applied to large dogs of the spaniel type employed for retrieving game on

land, in contradistinction to the water spaniels, which are used for the same purpose in water. These dogs have more or less Newfoundland blood in them, and trace their other parentage to the water spaniel or setter.

The curly-coated retriever, which may be either black or tan, is the product of a cross between the smaller black Newfoundland and the water spaniel, and is characterised by the short hair of the face, and the absence of any fringe to the tail, which is covered to



HAIRLESS MEXICAN DOGS



A WATER SPANIEL

HOUNDS

within a few inches of its extremity with short, crisp curls. The hair on the body is closely and crisply curled. The wavy-coated retriever may be either a pure-bred small black Newfoundland, or a cross between that breed and the setter.

The Newfoundland dog, of which there are three distinct breeds, is regarded as nothing more than a large spaniel, and its general form and the facility with which it may be crossed with spaniels and setters bear out this viewfully. The characteristic of the Newfoundland is its well-known fearlessness of water, and the readiness with which it will risk its life to rescue human beings from drowning.

The true Newfoundland is the largest breed, and should stand from 25 to 30 or 31 inches in height at the shoulder. The coat should be shaggy and somewhat oily, and the tail long and bushy and slightly curled on one side; the colour black, with or without some admixture of white, the specimens with the least white being the most admired. Sometimes the black has a rusty tinge. The head in the best-bred animals is large and broad, and nearly flat on the top, with a well-marked ridge at the eyes, while the expression of the countenance conveys a look of grandeur and intelligence without fierceness. The muzzle is relatively wide, and clothed with short hair, while the skin of the forehead should show some slight wrinkles. Both the ears and eyes are relatively small, the former being covered



THE LANDSEER NEWFOUNDLAND

with short hairs, which become slightly longer at the edges; while the latter should be brown in colour and mild in expression. The neck has no distinct frill, and the fore legs should be fringed above, but nearly smooth below. The feet, although necessarily large, should be compact, so as not to spread out under the weight of the body.

The Landseer Newfoundland, said to be unknown in the island from which these dogs take their name, differs from the preceding in its looser build, less noble appearance, more woolly coat, and by the ground-colour being white, upon which are black spots.

The smaller black Newfoundland, now generally known as the Labrador retriever, is inferior in size to the typical Newfoundland, standing not more than 22 or 23 inches in height, with a relatively smaller and less massive head. Its coat is moderately short and wavy, without under-fur, and should be entirely black, although there may be a white spot on the forehead or a white toe. The fore legs are fringed with long hair down to the feet. Of late years these dogs have become much appreciated by British sportsmen as retrievers; one of the finest strains being owned by the Hon. A. H. Holland-Hibbert at Munden, near Watford, Herts. A female from the Munden kennel is exhibited in the Natural History Branch of the British Museum at South Kensington.



A LABRADOR RETRIEVER

Photo C. Reid

THE HOUND GROUP

The bloodhound may be taken as the first representative of the fourth division of domesticated dogs, which includes pointers and all those usually denominated

hounds. They are characterised by their large drooping ears, and most of them by their smooth coats and the absence of any fringe of hair on the ears and legs, while the tail is in most cases but thinly fringed. The profile of the face is only slightly concave, and the muzzle relatively long and deep, with a more or less marked overlapping of the upper lip. With the exception of pointers, they hunt by "foot-scent."

The most striking characteristic feature of the bloodhound is its magnificent head, which is larger and heavier in the male than in the female. While extremely massive, the head is remarkable for its narrowness between the ears, where it rises into a dome-like prominence, terminating in a marked protuberance in the occipital region. The skin of the forehead, like that round the eyes, is thrown into a series of transverse puckers, which gives a peculiar and somewhat melancholy expression to the whole countenance.

The long and tapering jaws are of great depth but relatively narrow, and abruptly truncated in front, and the upper lips are pendulous. The large and thin ears should hang close to the cheeks, and the small and deeply sunk hazel eyes are characterised by the exposure of a considerable part of the membrane of the socket, which is generally red, and technically known as the *haw*. The throat is heavy, passing downwards into a more or less well-marked dewlap.

In the English breed the tail is slightly fringed with hair, although in some foreign strains it is smooth; it should be carried in a curve, but not raised above a right angle with the line of the back. The short coat should be coarse and hard on the back and sides, but soft and silky on the head and ears. The most esteemed type of colour is black and tan, but the coat may be all tan, although white is regarded as a blemish.

English staghounds are descended from two extinct breeds, the southern hound and the northern hound, both of which were large, heavily built animals, with thick throats, distinct dewlaps, and large pendent ears resembling those of the bloodhound. They were slow in pace, and dwelt upon the scent more than their modern descendants. The true English staghound was a considerably larger dog than the foxhound, with a relatively broader and shorter head, and a more thickly fringed tail, and also distinguished by several

points in the conformation of the limbs. The large hounds used for stag-hunting in England stand about 25 inches high in the males, and from 23 to 23½ inches in the females.

The modern foxhound, derived from either the old southern or northern hound, with perhaps some cross of a different breed, is remarkable for its combination of speed and endurance, and thus affords an excellent instance of the results that can be attained by breeding with a particular end in view. The appearance of the foxhound is much modified by the artificial rounding of the ears—a process in which a large portion of the extremity of the lobe is cut away in order to prevent it from becoming entangled in bushes. The coat should be short and hard, but at the same time glossy, the tail having a distinct fringe of hair on its under surface. The favourite, or true, colour is black, white, and tan; but there are also several "pies" in which the respective colours are

blended with white, while whole colours, or black and tan only, are not unknown.

The endurance and speed of the modern foxhound are fully attested in numerous works on sport. It has been observed that a peculiar faculty in which

the hound differs from his congeners is a mental one, leading him always, when he loses scent of his quarry, to cast forwards rather than backwards, and to do this with a "dash" altogether unlike the slow and careful quest of the bloodhound.

This, of course, may be overdone, and in that case the hound constantly overruns the scent; but without this property few foxes would be killed, for unless they are hard pressed the scent soon fails and is altogether lost. For ordinary country the male foxhound should average 24 inches, and the female 22½ inches in height, but in hilly districts smaller hounds are preferred.

Harriers are a breed of hound trained to hunt hares instead of foxes, and intermediate in point of size between foxhounds and beagles. Pure-bred harriers, probably descended from the old southern hound, are to be met with in Wales, but many of those used in England are crossed with the foxhound, while in some cases a small breed of foxhounds is employed in hare-hunting. Owing to the absence of the practice of "cropping," harriers may be



THE BLOODHOUND



THE FOXHOUND

HOUNDS

distinguished from foxhounds by their larger and pointed ears, and generally have longer and narrower heads, with a deeper hollow under the somewhat fuller eye. The height varies from 16 to a little below 20 inches. The colours and points are the same as those of foxhounds. A rough breed of Welsh harriers is practically indistinguishable from the otterhound. Harriers work more slowly than foxhounds, dwelling more on the scent and tending to cast backwards rather than forwards when they come to a check.

Otterhounds so closely resemble large rough Welsh harriers that it requires an expert to distinguish between the two, such difference as there is consisting in the nature of the coat and the form of the feet. Thus the feet, instead of having the neat cat-like form of those of harriers, are broad and splay; while the coat is furnished with a thick woolly under-fur of an oily nature. Probably owing to having to contend with such a fierce animal as the otter, the otterhound is of a savage and quarrelsome disposition, and very apt to engage in internecine conflicts with its fellow occupants of the kennel. Otter-hunting is a favourite sport in many parts of England and Wales. In some cases foxhounds are employed for otter-hunting.

Bassets (from the French *bas*, "low") are small, long-bodied, and short-legged hounds, intermediate in point of size between harriers and beagles; they are divided into straight-legged and bandy-legged bassets, the latter having the fore legs crooked. The heavy build, long body, and short legs render these dogs easy of recognition.

The name of beagle is applied to any normally formed hound—that is, to any except a basset—standing less than 16 inches in height, although the true pure-bred beagle is a distinct breed, which may be regarded as a miniature of the old southern hound. In build the beagle is rather short in the limbs and long in the body, with a relatively wide and somewhat dome-shaped head and a short nose. The throat is likewise rather short and thick, and the older breeds used to show a tendency to a dewlap. The ears are full and hang in folds. Beagles may vary in height from about 15 to 10 or 9 inches, but those from 11 to 12 inches are esteemed the best.

These small hounds, which are used in hunting hares and rabbits, have a remarkably musical note and an exquisite sense of scent, as well as great perseverance in following a trail. From their small size, short legs,

and rather heavy build, beagles are necessarily slow; and in hunting follow all the windings of the hare, so that during the first part of the chase they are far behind their quarry. Their perseverance, however, is generally successful in the end, and there is no prettier sight for the lovers of sport than to watch a well-trained pack at work.

With the cessation of its monotonous occupation has come about the practical extinction of the old English turnspit, which was a long-bodied, short-limbed dog, with the fore feet everted, closely allied to the dachshund, but relatively taller, with a longer head and nose, straighter forehead, less bent fore limbs, and a longer and thinner tail; the ears being small and placed relatively far back. In colour the turnspit was black and tan. These dogs per-

formed their task in a kind of wire barrel, somewhat like that in a squirrel cage; in England two of them were generally kept, which worked turn and turn about.

Under the title of dachshund, or badger-dog, Germans include two distinct strains of long-bodied dogs with short and crooked legs, one of which presents these characters in a less marked degree than the other, and has also relatively larger ears. One strain has a long, cylinder-like body, supported on short and bent legs, the head, muzzle, and drooping ears large, the paws of great size and furnished with sharp claws, and the coat short and smooth. The fore feet are markedly turned outwards, and the hind feet have large dew-claws; while the tail is thick at the root, from which it rapidly tapers to the end, without any

fringe. The colour varies, but is generally black and tan, although not infrequently either tan or yellowish, and sometimes grey or parti-coloured.

The second variety of the dachshund has a still longer body, and shorter and more bent legs than the other strain, from which it is also distinguished by its smaller ears and shorter tail. The ear is set farther back than in any other dog, its front border being scarcely in advance of the line of junction of the head with the neck. The tail should be carried over the back, and the smooth and glossy coat ought to be hard and wiry, except on the ears, where it becomes silky. Black and tan are the favourite colours in this breed, but

whole tan, with a black nose, occupies the second place in the estimation of fanciers.

Dachshunds are used in their native country chiefly for hunting badgers, which are numerous in some



THE BEAGLE



THE OTTERHOUND



DACHSHUNDS

districts. The strain with the longest body and the shortest legs is employed for digging the badgers out of their holes, while the other is used in the chase. From their small size and short limbs dachshunds are, of course, extremely slow, but they have a keen scent, coupled with great perseverance and endurance, and therefore make admirable hounds. From its somewhat squeaky voice the dachshund has been regarded as more related to terriers than to hounds, but there is no doubt that its place is among the latter.

That the various breeds of pointers are descended from the hound was first clearly indicated by William Youatt. The disposition to "point" appears to be due to the result of training; and although other dogs have been taught to point, in no case do they assume the rigid condition so especially characteristic of the pointer. Indeed, in some of the old Spanish and French pointers so intensely was this characteristic developed that the animals assumed a kind of cataleptic condition; some of them having been known to remain on the "point" for hours, until absolutely exhausted.

Pointers differ from hounds in hunting by "body-scent" instead of by "foot-scent." The most ancient breed appears to have been the old Spanish pointer, and from this breed the modern English pointer is believed to have been derived, with intercrossing either directly with the greyhound or indirectly through the foxhound.

This breed is characterised by its compact and well-knit build, sloping shoulders, straight, muscular limbs, and spirited action.

The head is still relatively large, but the pendulous upper lips, dewlap, and the heaviness of the throat of the old Spanish breed have been lost. The nose should be long, broad, and square in front. The eyes are moderately large, soft, and intelligent, the colour varying from buff to dark brown. A

peculiarly rounded outline on the upper side of the neck marks the well-bred pointer, which can hardly be described in words. The tail should be as straight as possible, with no trace of a fringe, sharply pointed at the end, and carried low. The coat is soft, although not silky. With regard to colour, there are two strains, distinguished as the lemon and white and the liver and white, which are the most numerous and the most

esteemed: in addition to these are entirely black and entirely liver-coloured pointers, the latter being very rare. There are also black and white, and black, white, and tan varieties; a dog with much white being preferred, in order that he may readily be seen among turnips.

In the best-bred pointers the head should be carried high when at work; those that have too much of the

foxhound in their blood carrying the head down, and seeking after a "foot-scent," instead of trusting entirely to the "body-scent," while their tails are not carried in the orthodox rigid position.

The Dalmatian, coach, spotted, or "plum-pudding dog," is probably allied to the pointer and hounds, although there have been suggestions of its affinity to the great Dane. It

is distinguished by its dark spots, which are by preference jet-black on a white ground; these spots are large and evenly distributed, varying in size from a shilling to a half-crown. In England essentially a carriage dog, next to the regularity of its spots attention is directed to the perfect development of the limbs. In its native country the Dalmatian

dog is employed as a pointer.

Griffon hounds, which must not be confounded with griffon terriers, are a Continental breed, and appear to have been originally of rather large size and uniformly white in colour, although there is now a strain of griffons which may be three-coloured, blue, grey, or lemon and white. These dogs are rough-haired, like otterhounds.

THE MASTIFF GROUP

With the mastiff we arrive at the fifth division of domesticated dogs, characterised by the more or less shortened muzzle, in which the lower jaw frequently projects beyond the upper, while the skull is greatly elevated above the eyes by the enlargement of the air-

cells in the frontal bones. The typical breeds are of large size and powerful build, with either pendent or erect ears, pendulous lips, and generally short coats and thin tails. They are used chiefly as watch-dogs, or for fighting.

Of the true mastiffs there are two breeds, the English and the Cuban. The modern English mastiff is a powerful dog of large size, distinguished,



AN ENGLISH POINTER

Photo C. Reid



A MODERN BULLDOG

when pure-bred, by its fully pendent ears. The head is relatively larger and the body less massive than in the bulldog; the head showing a slight furrow down the middle, small eyes, and short face. In height, the male should not fall below 29 inches, while the female should reach at least 27 inches. The coat is fine and soft, but may become rather rough on the tail. The colour most esteemed is either a stone-fawn with black "points," or a brindle, without any admixture of white; but red mastiffs are not unknown.

The bulldog is a smaller animal, distinguished by its ugly appearance and low degree of intelligence. The head should be square in shape, and as wide as possible, while the skin on the forehead should be well wrinkled. The indentation between the eyes, technically known as the "stop," should be of great depth and size, and the eyes should be dark, rather prominent, far apart, and set horizontally. The ears, which vary somewhat in shape, are required to be small, and placed high on the head, although not at its summit. Breeders also attach importance to the shortness of the upper as compared with the lower jaw, which is carried to quite an extraordinary degree in the modern breed.

The canines, or tusks, should be large and powerful, and the incisor teeth ought to form a regular series. The shape of the body and limbs is admirably adapted for the attainment of the maximum strength and power. A male should not exceed 50 pounds in weight, while the female should scale about 10 pounds less. The coat should be close and fine, the favourite colours being pure white, black and white, or white marked with brindle, fallow, or red; while uniformly coloured brindle, fallow, or red dogs come next in estimation.

The modern type of bulldog appears to have been derived from a breed which, as shown by old pictures, was of a much more mastiff-like type. Bull-baiting was a recognised sport in the thirteenth century, and there is a record dating from the early part of the seventeenth century in which a sharp distinction is drawn between bulldogs and mastiffs. The old type was a fighting dog, and it was essential that an animal which makes a frontal attack on a bull should be both underhung and short-legged, in order to be able to get a firm grip of the muzzle of its antagonist, and to avoid being gored by its horns. It may therefore be taken for granted that whenever a distinct breed of bulldog was differentiated from the mastiff type it possessed in some degree these characteristics.

Of the bulldog skulls in the British Museum two are much more like the skulls of mastiffs than those of modern bulldogs, although they are distinctly, if slightly, underhung. Nothing is known as to their history, except that they were in the collection in 1862, but it is probable either that they are much older than that date, or that they belonged to survivors of the ancient type of the breed, for a third skull in the series, belonging to the Lidth-de-Jeude collection, acquired in the 'sixties, is

of the modern type, and has nothing of the mastiff about it. Of the two mastiff-like skulls, one is decidedly shorter than the other, and therefore indicates an approximation to the modern type. The Lidth-de-Jeude skull, which belonged to an animal of huge size, although resembling in general characters modern bulldogs, is much more powerful and decidedly less underhung than the skulls of modern bulldogs. With the loss of its fighting power, the bulldog has likewise discarded most of its original ferocity.

The bull terrier, as its name implies, is a cross between the bulldog and the smooth terrier, but varies in form and size according to the amount of bull or terrier blood. The jaws must be long and powerful, and the hollow between the eyes of the bulldog should be quite eliminated, while the profile should be nearly straight. The coat should be short, firm, and close, and, in a perfect animal, milky-white throughout, with the nose black. The worst point about a bull terrier is its quarrelsome disposition, which is rendered all the more objectionable by its courage and strength.

The great Dane, or German boarhound, is the largest European representative of the mastiff group. These dogs have long been bred in Germany and Denmark, whence they were originally introduced into England. The great Dane is a magnificently proportioned animal, with

slender limbs, rather pointed muzzle, slender tail, and large, full eyes. It is generally either yellow and black, or yellow in colour; but may be black, light or dark grey, brown, or yellow, the light shades being often brindled.

There are frequently white spots on the chest, and one or more white toes in the lighter-coloured examples. An unusually large dog measured upwards of 35½ inches in height at the shoulders, when in its third year. At one time the ears were invariably cropped, and

thus lost their pendent tips. In the Black Forest these dogs are still used in hunting the boar and stag; but are elsewhere mostly employed as watch-dogs. Some authorities are of opinion that a distinction may be drawn between the great Dane and the German boarhound, although this is not accepted by most writers on dogs.

A purely fighting breed is the so-called "dogue de Bordeaux," a French bulldog of the south of France, which is a short-coated dog, typically of a reddish fawn colour, with a redder face. In shape this dog is rather low, massive, and muscular, with an enormous head and powerful teeth. The head is both long and broad, with a wide, deep, and powerful muzzle, and a relatively short face and slightly underhung lower jaw.

A deep furrow extends from between the small and deeply-set eyes on to the forehead, and the "fews" are thick, broad, and pendulous. When uncropped the pendent ears are small and fine; and the skin of the whole of the head should hang in symmetrical folds. The whiplike tail should be altogether devoid of fringe. Despite their inferior size and weight, these dogs are more powerful and more active than either mastiffs or great Danes. On the Continent they are pitted not only



THE FRENCH BULLDOG

against one another, but against bears, wolves, and other large animals.

The curly-tailed pug-dog, which is a diminutive member of the mastiff group, is kept solely as a pet, and has suffered from the caprice of fashion in England, where it was much esteemed in the eighteenth century, until it fell into the neglect from which it was afterwards rescued. The colour is either yellow or stone-fawn, with black "points"; these black points comprising the face and ears, an area under the tail, and a more or less well-marked streak down the back, which, in the Willoughby pug, is most esteemed when it spreads out into a saddle-shaped patch. The coat should be soft, short, and glossy, except on the tail, where it should be rougher; the tail itself being tightly curled, so as to lie on one side of the back, with rather more than one complete turn.

The head is rounded, and second only in relative size to that of the bulldog, with a short but not retreating face. The black ears should be short, and shaped like a vine-leaf; the teeth even; and the dark brown eyes full and soft. The body is thick and "punchy," with a very loose skin; and the legs should be straight, with small bones, narrow feet, and dark nails, without any white on the toes. A black mole on each cheek, with several long hairs growing from it, is also con-

Europe, the Japanese pug, is a still more remarkable dog, exhibiting a kind of degradation from overbreeding. One of these brought to England about 1867 was a slender-legged dog with very long hair, and the bushy tail closely curled over its back. The face was extremely short, and the jaws very feeble, with only a single pair of incisor teeth in the lower one. This pug lived chiefly on vegetables, and displayed a special partiality for cucumbers.

The Tibet dog is a magnificent animal, usually placed among the mastiffs, with which it agrees in the general physiognomy and the large pendulous upper lips, or "fews," as they are technically termed. It differs, however, from all the foregoing members of the group by its coat of long, shaggy hair, with a thick under-fur, and the large bushy tail, carried curled over the back. The development of this thick coat, however, is doubtless an adaptive character due to the winter climate of its native regions. The expression of the countenance is stern and fierce, from the deeply sunken eyes, overhanging eyebrows, and the deep folds into which the skin of the forehead and cheeks is thrown. The ears are pendent, and the greatest development of hair is on the throat and chest. In colour these dogs may be entirely black, black and tan, or tan; and in size they are fully equal to the largest European dogs.

The Tibet dog is the watch-dog of the villages and encampments in the highlands of Tibet and neighbouring regions, extending westwards into Ladak and southwards into Sikkim. It is invaluable in protecting the flocks from the inroads of wolves and wild dogs. On reaching a Tibetan village or encampment in the higher regions of Ladak, the traveller is assailed by the baying of at least half a dozen of these dogs, and until they are called off the sensations of the visitor are sometimes the reverse of pleasant. In the more eastern portions of its range the Tibet dog, in common with sheep and goats, is pressed into service as a beast of burden for carrying salt and borax across the elevated passes and plateaus.

The splendid dogs taking their name from the monastery of Mount St. Bernard, and formerly unknown beyond the Alps and adjacent regions, are remarkable for their high intelligence, and are used in the Alps for rescuing travellers lost in the snow. They were formerly classed in the spaniel group, but, according to one well-known authority—whose views, however, are by no means universally accepted—both Tibet dogs and St. Bernards are descended from the great mastiff-like "Molossi," or Molossian dogs, of the ancient Greeks and Romans.

In size St. Bernards attain dimensions only equalled by those of the great Dane, and are larger than any wild member of the family, unless it be the Alaskan wolf. A very large St. Bernard known as "Young Plinlimmon" measured 68½ inches from the tip of his nose to the root of his tail, while others are known which measured respectively 64, 63, and 60 inches.

These dogs are divided into rough and smooth St. Bernards, according to the length of the hair. The rough St. Bernard has the coat of the body long and wavy, with the tail very bushy, and the fringe on the fore legs comparatively small. There is great variety in colour; one strain being a rich orange tawny mixed with brown, while others are red and white, brindled or fawn, or those colours more or less mixed



THE TIBET DOG

sidered an essential point in a pug. The second strain is the Morrison pug, characterised by its richer and yellower colour, and the absence of an excess of black, notably in the lack of a black patch on the back. The two breeds, however, are now more or less completely blended.

The Chinese, or, as it is often incorrectly called from being imported into Japan and thence brought to

TERRIERS

with white, and some almost white. The head is large, with a higher elevation at the eyes than in that of the Newfoundland, and the muzzle rather long and squared, with slightly pendulous lips. The ears are relatively small, with the hair rather rougher than that of the body. The eyes are full but deeply set. The feet are very large, apparently for the purpose of supporting the animal in the snows of its native home, and may be furnished with double dew-claws. The smooth St. Bernard differs mainly from the rough breed by its nearly smooth coat; the tail being comparatively thin, and the legs and ears entirely free from fringes of hair.

THE TERRIER GROUP

All terriers have moderately short and highly arched skulls, in which the elevation is mainly due to the large size of the braincase, and consequently indicates a high degree of intelligence, the jaws being generally rather short.

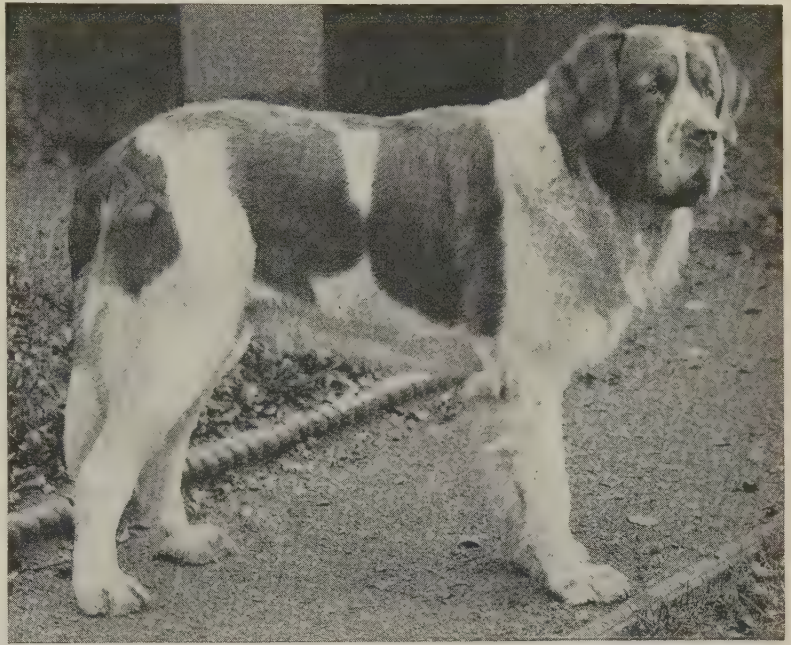
The smooth fox terrier is now one of the most favoured breeds of companionable dogs. It should have a hard, thick, and glossy coat, of a pure white ground-colour, more or less fully marked with black and tan, black, or lemon colour, liver-coloured markings being objectionable. The true colour—namely, white and black and tan—is the most esteemed.

There has been much discussion as to the advisability of a strain of bulldog blood in the smooth fox terrier; such strain showing itself by a tendency for the lower jaw to be "underhung," and also an unusual massiveness of the jaw muscles. The weight may vary from 15 or 16 to 20 pounds. In a pure-bred dog the head should be flat and rather narrow, tapering from the ears to the muzzle, with a slight hollow in front of the eyes, but none behind them. The jaws should be long and tapering, with a moderate prominence of the masseter muscle; and the nose must be black. The eyes are small, without prominence; and the ears likewise small, in shape resembling the letter V, and set close to the cheeks, with their points directed forwards and downwards.

The rough fox terrier came into popular favour at a later date than the smooth breed, although it had been bred for many years in the west of England. It is in all respects similar to its smooth brother, with the exception of the coat, which on the body and legs should be about twice the length of that on the smooth dog, with the addition of a thick under-pile of a woolly nature, and furnished, like that of the otterhound, with a certain amount of oil, so as to resist the action of water.

The rough Irish terrier, which has of late years to a great extent replaced the old Scottish terrier, is a rather large dog, varying in weight from 17 to 25 pounds, with a hard, rough, and wiry coat, showing no tendency to curl. The most admired colour is bright reddish bay, usually termed "red," but it may vary through different shades of brown and yellow to grey. The tail is generally cut, but if kept entire should curve. The form of the head should be long and rather narrow, without any wrinkles or hollow between the eyes. When uncut, the ears should be small, filbert-shaped, and lying close to the head, without any fringe of hair, and rather darker in colour than the head. The small eyes should be hazel, and the nose black.

Very different from either of the above is the long-bodied, short-legged, and long-haired Skye terrier, of which there are two distinct breeds, distinguished by the form of the ears and the proportionate length of the body. The first of these is the drop-eared, or smooth, Skye, in which the ears are pendent, and the body almost or quite as long proportionately as in the



THE ST. BERNARD DOG

Photo - C. Reid

dachshund; the length of this dog; from the tip of the nose to the end of the tail, being in perfect specimens as much as three and a half times the height. The coat should nearly touch the ground and almost conceal the shape of the body; the long hair being straight, coarse, and shiny, and naturally parting down the middle of the back, while beneath this there is a thick, woolly under-fur.

The most approved colours are "blue," black, or grizzle, next to which comes silver grey with the hairs tipped with brown, and then fawn with the tips of the hairs also brown. The long hair makes the head appear larger than really is the case. It should be rather narrow, and nearly flat at the top, with little or no elevation at the eyes. The nose and the roof of the mouth must be black or dark brown, and the ears should be about 3 inches in length. The latter should have very long hair, which, together with the long hair of the eyebrows and cheeks, should fall over the eyes. The height of the Skye terrier varies from 9 to 10 inches; the length in the former case varying from 30 to 33 inches. The prick-eared Skye is a shorter-bodied dog, with a larger and squarer head, a rougher coat, and large, pointed, erect ears, terminating in a distinct tuft.

Much alteration has ensued in the appearance of the Skye terrier through the fancy of breeders, but the modification is not nearly so great as that which has taken place in the Dandie Dinmont, the height of which varies from 8 to 11 inches at the shoulder, and the weight from 14 to 24 pounds. The hair on the top of the head is soft and silky, but that on the jaws is harder and darker. The upper surface of the tail has wiry hair of a darker tint than that of the body, while below it is softer and lighter in colour. The ears terminate in a distinct point of hair. The prevailing colour is either "blue" or "mustard," but in the former case the

hair on the forelegs and feet should vary from tan to fawn, and in the latter they should be darker than the creamy white head. The ears vary from brown to black, and the eyes are hazel.

The Yorkshire, or Halifax, terrier is a small breed, recognised by the enormous length of the long and silky hair, especially on the face. On the body the length of the hair is about 3 or 4 inches, while on the face it reaches as much as 6 or 7, and thus communicates an almost grotesque appearance. The colour on the upper parts is grizzled "blue," owing to the mixture of dark with light hairs, while tan occupies the same parts as in the black and tan terrier.

The "griffon bruxellois" is a small and vivacious rough-haired breed, indigenous to Belgium, which has of late years come into fashion in England. In their native country these dogs have the ears cropped and the tail docked.

Under the title of English terriers may be included the short-haired dogs, commonly known as black and tan terriers, with their diminutive representatives the toy terriers and white terriers. The black and tan, or Manchester, terrier is of about the same average size as the fox terrier, varying in weight from some 10 or 12 to as much as 18 pounds. Special attention is paid to the colour of this terrier, the black being required to be of jetty fulness, and sharply defined from the tan, which should be of a rich mahogany. The tan should occupy a spot, forming a "bee," over each eye, and another on the cheek, as well as the sides of the jaws backwards to the lower parts of the cheeks, ending on the throat. The tan should also occupy all the under parts, the inner sides of the ears, a spot on each side of the chest, the whole of the inner sides of the limbs, their outer sides as far as the wrist and ankle joints, and the entire feet, with the exception of a narrow line of black along each toe.

The black and tan toy terrier, which is merely a diminutive derivation from the Manchester terrier, should not exceed 6 pounds in weight, and is most prized when it only weighs $3\frac{1}{2}$ or 4 pounds, if at the same time it exhibits perfect symmetry. The white English terrier is a less well-known breed, having the same general characteristics as the Manchester terrier, but a pure opaque white coat, and dark eyes, nose, and claws.

Although very different in appearance from the typical representatives of the group, the poodle, perhaps the cleverest of all dogs and the one most apt to learn

tricks, is included among the terriers. There are several strains, differing mainly from one another in size: the usual colours being either black or white, a mixture of the two, or grey. The coat should resemble astrakhan, but may incline more to a silky or a woolly nature in the different strains. When clipped it should present a satiny sheen. Both on the Continent and in England the poodle is clipped to a greater or less degree; but while on the Continent the coat is permitted to grow in winter, in England the clipping is too often continued at all seasons. In England and Russia the poodle is treated solely as a companion and house-dog, but in France and Germany is employed as a sporting dog, and is the constant outdoor companion of the farmer.

The poodle is an excellent water-dog, diving well, and seldom failing to retrieve a wounded bird in the water; the oily nature of its coat being a protection against chills. In retrieving on land the poodle relies fully as much on its general intelligence as on its sense of

smell, thereby resembling the Newfoundland; and it usually hunts by casting round in circles, rather than by following a direct trail. Poodles are the dogs employed in circuses as performers, and have frequently been taught to recognise and pick out many of the cards from a pack at the direction of their masters.

As a remarkable instance of intelligence, Dr. Romanes related a case where a poodle, having on one occasion conducted his master to the larder, and been rewarded with a piece of meat, essayed to lead him again to the same spot. Baffled in this attempt, the dog thereupon took up his master's hat, with which he proceeded to the larder, and lay down beneath the shelf on which was placed the coveted joint.

The Maltese dog, which may be compared to a diminutive Skye terrier, and should not exceed some 5 or 6 pounds in weight, has a short body, covered with very long and silky hair of a uniform semi-transparent white colour; the tail being thickly haired and carried tightly curled over the back. The nose and roof of the mouth are black, and the hair of the moderately long ears, as in the case of

other terriers, mingles with that of the neck.

The Mexican lapdog is also pure white, but with a flesh-coloured nose. The hair on the head and body is moderately long and curly, but that of the rather short tail longer and straighter. The ears are small and not pendent, and the head is rounded, with the brown eyes widely separated from one another.

R. LYDEKKER



SMOOTH FOX TERRIER



THE IRISH TERRIER

STORIES OF DOGS

Many learned persons have gone to dogs, seeking to discover whether these friends of men possess reason or only blind instinct. The scientist coldly declares that the dog has given no proof of reason. The ordinary person who keeps and loves a dog is convinced, beyond the possibility of doubt, that the dog *has* reason; that it has the most highly organised of all animal brains. Women are unanimously on the side of the unscientific man. It would be hazardous to tell a lady who refuses £1,500 for a little Pekinese that her treasure is only an unreasoning, animated toy. Still greater would be the peril of one who laid it down to a Yorkshire miner that his whippet or champion ratter possessed no higher psychological faculties than, say, the rabbit.

The stern, unbending scientist, Professor Alexander, for example, lays it down that the dog has no power to put two and two together. If that be so, then what means the performance of an irresistible little Schipperke known to the present writer? When he sees his master sit down to write a letter, he knows that that letter has to be taken to post, that his master will take the letter himself, and that he, 'cutest of dogs, will accompany him. If he does not put two and two together, why does that Schipperke go almost frantic with delight as soon as the writing cabinet is opened, and why does he drag in his master's boots in readiness for the walk which is to follow? Observation has taught that dog all he knows in the matter; he has not been instructed to bring in the boots, he has not had his attention drawn to the letter-writing. The performance seems a pretty good imitation of reasoning power.

Ask if all his actions are in keeping with this evidence of sagacity, and the answer is emphatically in the negative. A marvellously intelligent little beast in the house, once he escapes his master's premises he is the wildest vagabond on four legs. Yet, returned to the realm of authority, he bows again to reason, and would no more think of entering that disciplined household without his paws having been wiped than he would think of flying.

Another dog who possessed remarkable untrained powers was owned by the same gentleman. It was a retriever, and adopted a younger son of its owner. The youngster took him once or twice on a round of calls. The visits were the same each time, and made in the same order. "Wait," was the order given, and the dog would lie down in the street outside the office, then accompany his protégé as the latter came out and moved on. This happened a few times—say, half a dozen—distributed over, perhaps, as many weeks. Then one morning the dog escaped from home and bolted off to town in quest of his friend. He nosed his way into the latter's office, and not finding him there,

went on the round of calls himself. Each place in turn he visited, and not finding the object of his quest, returned to the office, caught up his man there, and took him home to lunch. From that day the dog did the round as often as he could get out. Sometimes his mistress would release him at the right time; at others he would be free some time earlier. But he never appeared on the round of visits until the proper time.

Only once did he have a blank day. On that occasion his friend was absent from town and did not return at night. The dog did his round, then went back to the office. His master not appearing, the faithful brute would not go home. No man on the staff cared to risk putting him out, and he remained there all night waiting for the youth who he knew ought long before to have been there. The dog knew that food awaited him at home, but he remained famishing at that office, unfed, until some member of the night staff took pity on his hunger and tossed him a few scraps towards midnight. The protégé of that treasured animal was the present writer, who, in view of all that loving brute taught him, has no difficulty in believing many of the stories told of dogs following their masters to the grave and dying there.

Some dogs have a genius for friendship, other dogs have a genius for malice and the incurring of enmities. No better example comes to mind than Mr. Richard Lloyd Price's story of that outrageous fox terrier "Jack," which Mr. Price presented to Queen Victoria, to take the place of a dog of the same breed for whose loss her Majesty was at that time grieving. Forwarded to Windsor Castle, "Jack" was installed in high honour, and beyond a pretty little letter of acknowledgment the donor heard no more for a couple of years.

Then arrived a letter from one of the Queen's ladies, telling a tale of the misbehaviour of "Jack." He had thoroughly abused the Royal favour. He had bitten the calves of the Royal footmen, worried the Royal grooms, fought with every dog in Windsor, and ended up by mauling and maltreating a favourite collie of the Princess of Wales. Mr. Price took him back, and found that the dog was an unmitigated little rascal, so sent him to Aldridge's. There he was knocked down at half price to a livery-stable keeper,

whom he bit in the calf as he was being led home; then vanished into the gloom of gathering night, no more to outrage the favour of Court or reputable society.

Quitting the disreputable dogs, we may turn to another type—the dogs which combine humour with reason. What could be better than Grant Duff's story of the parson's dog which used to sleep at nights with its master's children? It never knew with which child it would sleep. That question had to be decided by right of battle when bedtime came, the winner of



THE SCOTTISH TERRIER



THE YORKSHIRE TERRIER

the contest claiming the dog for his prize. One evening all the family had gone out to some function, leaving supper, consisting of meat-pies and little cakes, on the kitchen table. On getting home they found that all these had disappeared. When the children went to bed, each child found under its counterpane a meat-pie and a little cake, placed there, in his uncertainty, by the dog, so as to be prepared for all emergencies.

This story is matched by one of more dubious authenticity. Its hero was the famous dog "Minos," which sent society wild when "thinking horses" and educated pigs had not been invented. "Minos" was a very big lion for a brief but crowded hour, and upon invitation cards "To meet the dog 'Minos'" was regularly inscribed. This dog was an accomplished courtier, for, being told to take something to the most beautiful woman in the room, he presented himself to Queen Victoria, who good-humouredly flicked him in the face with her pocket-handkerchief. "Minos" trotted next to the then Princess of Wales, and this time was not in error. The achievement of "Minos" which matched the parson's pet, however, was his attitude towards a plate upon which lay three sandwiches. Left alone in the room with these dainties, he could not resist a temptation which would have tried even a well-bred child. He ate the sandwiches, but found three visiting-cards, and deposited them in their place!

Some men have a gift for bringing out all that is best in the canine temperament. Such a man is a friend of the writer, a man who, so far from being an expert, could not tell a sheep-dog from a collie. Yet he has that mystic gift which enables him to claim permanent friendship with the worst-tempered of dogs, as surely as by a word and a caress he can master the most savage horse in his father's stables. He never had a "good" dog in his life, but he has had a few bad ones, to which he has offered asylum that the bad ones' lives might be spared. He is the idol of a fairly aged collie, whose ill-temper, brought about no doubt by his being chained up as a yard-dog, made his owner decide to commit him to the lethal chamber.

The saviour appeared, begged the old dog's life, and got a nip in the calf for his pains as he led the animal home. In half an hour that dog, which was neither beaten nor scolded for his assault, seemed penitent, and anxious only to atone. Treated with confidence and kindness, he became a reformed character, and to-day he frisks and gambols like a puppy. He was admitted to friendship upon hearthrug terms; he was allowed to accompany his new owner about the farm, enjoying a liberty to which he had all his life been a stranger. Very soon, without a lesson, he would trot out of the room and bring in his master's boots and lay them at his feet, and eclipsed himself when, mistaking one pair of shoes for another, he was

admonished: "No, not these; the others!" The remark was made in the expectation that the dog would take no notice; but he jumped up, ran back with the boots, and returned with the right pair.

Darwin considered the act of a dog which runs off with a stick, then waits for you to approach before it runs just beyond reach again, as the beginning of humour. A step farther must have been taken, then,

by a dog whose performances have been described in "Nature." This animal passes most of his time in a library, where a basket and rug are provided for him. He prefers, however, whenever possible, to take possession of his master's easy-chair. One day, when his master received a visitor, the dog lay in the said chair, and was removed by his master to a basket.

The dog showed resentment at this disturbance, and became very restless. Presently he trotted over to the door, which he rattled by pushing with his nose, his usual



WHITE AND BLACK POODLES

method of attracting attention when he wished to go out. His master immediately opened it; but instead of the dog going out, he rushed back and into the chair which his master had just vacated. The rapid wagging of his tail, and the expression upon his face, showed the dog to be well pleased with the result of his ruse. Having once practised the deception, the dog afterwards repeated it, with evident delight to himself.

The Schipperke to which reference has already been made has pre-empted a special chair. It is not his; he has simply claimed it. An armchair of comfortable appearance, it is just the chair into which one naturally sinks on entering the room. This makes the dog furious. He sniffs and whines, and growls with amusing earnestness at the intruder, and will not rest until the chair is surrendered, when he leaps up, curls himself as though to sleep, and, with that peculiar "smile" with which a tailless dog expresses satisfaction, reclines at his ease. The moment he feels that he has established his title to the chair he will slip down, then go and make friends with the person whom he has evicted, but cut back to the chair should anything suggest a re-occupation.

James Hogg, the Ettrick Shepherd, had a treasure of a sheep-dog to which he was devoted. One day in winter a heavy fall of snow occurred, and Hogg was in great anxiety about his flocks. He called the dog and explained the matter to it, as only a shepherd can propound a problem to a sheep-dog. Then he set off to scour one side of the moor by himself, while the dog was to go round the other way and collect the sheep scattered there. The dog understood. Late in the evening Hogg reached home, perfectly exhausted, bringing in his flock through the deep snow, but the dog had not returned. Hour after hour passed, but the dog did not appear. At last the shepherd heard

AZARA'S DOG

a whining and scratching at the door, and, going out, found that the dog had brought all the sheep safely home. In its mouth was a tiny puppy, which it laid at the feet of its master, and instantly darted off through the snow. The poor creature had given birth to puppies in the snow, but would not on that account neglect one iota of its duty. It presently returned, bringing in a second puppy. This it laid in its master's lap, looked up wistfully into his face, as if beseeching him to take care of it, then lay down and died.

Creator of fun himself, the dog can appreciate a joke which we ourselves make. But you cannot trick him again and again as they tricked the great ape at the Zoo. What we shall call "reason" soon helps some dogs, at any rate, to see through a trick. Take the case of a Scottish sheep-dog upon which his master deliberately imposed by saying quietly to a visitor: "I'm thinking, sir, the cow's in the potato-patch." The dog immediately leapt up, sprang through the window, and scrambled up on to the low turf roof of the hut.

Not seeing the cow among the potatoes, the dog ran to the cowshed, found the cow there, and returned to its place before the fire in the hut. The shepherd repeated the same trick, and again the dog went out. A third time the shepherd tried, but this time the dog was too wise; getting up, it growled, showed its teeth as in a smile, and then lay down.

Those who deny the dog reason have never satisfactorily explained how, in the absence of this attribute, the animal achieves such wonderfully close imitations of the results of pure reasoning as in the following instance. Mr. "Alpine" Nutt, the well-known bookseller, possessed a couple of fox terriers, whose rambles took them frequently to the neighbourhood of King's College Hospital. One day they entered the hospital, escorting a drover's collie, which had been injured in the roadway. They waited until it had been treated by a kind-hearted surgeon, then took their departure in triumph. Mr. Nutt's explanation is that the dogs, frequently seeing people taken to the hospital who had met with accidents, agreed, when their friend came to misfortune, that what was good for man was good also for his dog, and so led him to the operating-room. An effective picture of the incident hangs in the board-room of the hospital (page 100). If that were an isolated case one might doubt that anything but a coincidence led up to it. But there are many others.

E. A. B.

THE MANED WOLF

The so-called maned wolf (*Canis jubatus*), a name in every respect a misnomer, since the creature is neither distinctly maned nor a true wolf, is a South American species, which forms by itself the subgenus *Chrysocyon*, and is specially characterised by its large size—equal to that of an average wolf—very long legs, and moderately long tail. The aguara guazu, as this species is termed in South America, is a long-legged and long-

eared dog, with a very conspicuous colouring; the body being covered with long and somewhat coarse hair, more lengthened on the back of the neck than elsewhere, and the general colour bright yellowish red. There is, however, a black patch extending from the nape of the neck towards the shoulders, and black is also present on the under surface of the lower jaw; while the legs have black "stockings," standing out conspicuously against the red colour of the body. The under surface of the upper part of the throat, the insides of the ears, and the tip of the tail are white.

The maned wolf inhabits Brazil, Paraguay, and Northern Argentina, but does not extend so far south as the Pampas. It differs from true wolves in being entirely solitary, never assembling in packs, and also in being harmless to men. Generally found in moist regions, it lies concealed during the day in bushes and thickets, and does not venture forth till evening for its nightly wanderings. It preys upon various species of rodents, but its diet is varied by birds, reptiles, insects, and even fruits; while it will sometimes attack deer and, more rarely, sheep. Owing to its nocturnal habits the maned wolf is rarely seen in inhabited districts, but in regions remote from human habitations it is less cautious and will issue forth during the day.

AZARA'S DOG

The comparatively small Azara's dog (*Canis azarae*) is one of several allied South American species presenting a more fox-like appearance than any of those



THE MANED WOLF

described already; this being especially shown by its long body, short legs, large ears, and long, bushy tail. And yet these South American species, although always called foxes by English residents in Argentina, are not foxes in the proper sense, as their skulls agree with those of wolves and jackals, and are quite unlike those of true foxes, which are unknown in South America. These species collectively constitute the subgenus *Cerdocyon*. Azara's dog ranges from Paraguay and the Chilian Andes to Patagonia and Tierra del Fuego. Typically the colour of the sides

of the body is grey, but the longer hairs of the back are black and white, with black patches on the shoulders, the middle of the body, and the rump; the limbs being fulvous on the outside, and of a pale yellowish tint on the inside.

The under parts of the body and the inner sides of the thighs are whitish; and there is also some white on the upper lip and on the chest, as well as on the inner sides of the ears; the outer sides of the latter being yellowish, with black tips. The tail, like the back, is mottled with black and white throughout the greater part of its length, but the end is black. White specimens have occasionally been observed.

In Paraguay this dog dwells in jungle-clad districts, from which during the night it roams on the one side into the dense forests, and on the other into the open country. Its main food consists of small mammals and birds, but it will not refuse lizards and displays a marked partiality for sugar-cane. In hunting it runs with its nose close to the ground, but will at times raise its head to the wind. For the greater part of the year Azara's dog is a solitary animal, but during the winter pairs of males and females go together. The young are born in the spring, and comprise from three to four in a litter. The lair may be formed either beneath the cover of a thick bush, or in the deserted hole of another animal, such as an armadillo, but it does not appear that the aguarachay, as it is termed in South America, ever burrows for itself.

THE CRAB-EATING DOG

The crab-eating dog (*Canis thous*) is a rather larger species than the last, sometimes attaining a considerable size and having a relatively shorter muzzle and tail. It inhabits the regions from Guiana and Brazil to Argentina, and occurs on the open Pampas, where it has been confounded with Azara's dog. As there are several local races—such as *C. t. angulensis*, Brazil; *C. t. melampus*, Brazil to Argentina; and *C. t. savannarum*, Guiana—it is impossible to give a description which will apply to all. The prevailing colour, however, may be either uniform light reddish grey, or darker and mottled. It may have a black back and bright red legs, or may be a dull grey, with very little black, or grey with a very black back. The normal tint seems to be a brownish grey above, with the crown of the head, sides of the body, and outside of the limbs slightly or strongly rufous. There is generally more or less black on the back and the upper surface of the tail, the end of which is always black. The reddish brown ears have not the black tips of Azara's dog.

The carasissi, as this dog is called in some parts, is a ferocious or jungle-dwelling species, feeding not only on rodents and birds, but also on crabs, thus earning its common English title. It is stated that these animals will collect in packs and run down and kill deer; and they do much damage to poultry in inhabited districts. Although when hunting in the woods they follow their prey by scent, in the open they hunt by

sight, and their general habits are fox-like. The names *C. cancrivorus* and *C. rudis* are synonyms of this species; but *C. griseus* of Southern Patagonia is distinct.

THE COLPEO

The largest and handsomest of the South American fox-like species is the colpeo (*Canis magellanicus*), from Chile, Bolivia, Catamarca, Patagonia, and Tierra del Fuego. Somewhat superior in size to the



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largest individuals of the preceding species, it is distinguished by its longer and more pointed nose and the great length of the more bushy tail, while its colouring is generally of a more decidedly reddish hue. As in the crab-eating dog, there is considerable variation both as regards the colour and length of the fur. Generally, however, the sides of the body are brownish grey, while the back is mottled with black, and the limbs are more or less rufous; the cheeks, throat, under surface of the lower jaw, and the under parts being yellowish white.

The ears are dark externally, while the bushy tail is of a light reddish

grey, except the tip and patch on the upper surface near the root, which are black. The colpeo inhabits alike the moist forests of Tierra del Fuego and the arid deserts of Northern Chile.

THE SHORT-EARED DOG

The short-eared dog (*C. microtis*), from the valley of the Amazon, is about the size of medium examples of the crab-eating dog, measuring 42 inches in total length, of which 12 are occupied by the tail, and standing about 14 inches at the shoulder. It differs from other members of the family, except the next, in its short and rounded ears; and is further noticeable for its colouring, the fur being short and thick and generally of a dark iron-grey hue, with hairs black at the tips and white near their roots. The limbs and bushy tail are nearly black, but the latter has a white patch on the under surface near the root; and the ears and snout are rufous.

THE RACCOON DOG

This curiously coloured and short-eared species, representing the subgenus (or genus) *Nyctereutes*, takes its name from a superficial, although striking, resemblance to a raccoon. The raccoon dog (*C. procyonoides*), which inhabits Japan, China, and Amurland, is characterised by the sharp and pointed muzzle, the short rounded ears, the rather short and bushy tail, and the great length of its fur, more especially during winter.

There is much variation in colour, the prevailing tints being dusky yellow and black, but in different proportions. Black, however, is always present on the cheeks and round the eyes, extending forwards to the muzzle, where there is a white spot below the nose on each side. The sides of the head are yellowish, and the forehead may be either of the same colour or blackish. The ears, which have brown margins, are white internally, and sometimes partially so externally. The chin and front of the neck are brown, but a yellowish colour may

extend backwards towards the shoulders. The whole of the back has fur varying from a mixture of black and yellow to nearly black, the individual hairs always having long black tips. On the sides the tips of the hair are yellowish, and the chest and under parts vary from brown to nearly black, while the limbs are blackish brown.

The tail, on which the hairs are long and pendent, is frequently black above and at its extremity, while below it may be light yellow. The raccoon dog is chiefly a nocturnal animal, dwelling in summer in the wood-clad mountains, and in winter descending to the neighbourhood of the river valleys, where, when in good condition, it is said to hibernate. In Amurland, where it does not hibernate, it feeds largely on fish in winter, reposing during the day in the thick sedges of the river banks. The asserted hibernation of this animal is a remarkable feature, since no other member of the family takes a winter sleep. The hibernation is stated to take place in the deserted burrow of a fox, or some other animal; but the raccoon dog also constructs its own hole. The individuals which do not hibernate may be seen in winter crossing the ice-bound rivers in a succession of short jumps.

The raccoon dog is far from wary, and, as it is almost omnivorous, is easily killed by means of strychnine. The fish which forms its favourite diet in winter is a kind of carp; but in summer its chief food consists of mice, which are pursued either by small companies or by family parties. Fruit also constitutes part of its diet. It does little or no damage to poultry, and in Japan has been known to make its winter lair beneath the walls of a house. Both its fur and flesh are held in high estimation by the Japanese. Some years ago a white specimen was exhibited in New York.

THE FOX

One of the characteristics by which the skulls of the wolves and the other members of the dog family already described may be distinguished from those of the foxes has been mentioned on page 438. To this it may be added that the frontal bones of the skulls of the former group are swollen by internal air-chambers, which are wanting in those of the latter. The pupil of the eye, when contracted, is also circular in wolves, jackals, and domesticated dogs, whereas in foxes it is elliptical. Some of the fox-like South American species, however, resemble foxes in this respect, as they do to a more or less degree in external form. Foxes also differ from all other members of the family in having only six teats; and they are further characterised by their slight build, their long, bushy tails, which are nearly always more than half the length of the head

and body, and short limbs; while they generally have large ears. All the members of the group are chiefly nocturnal in their habits, hiding during the day in holes or burrows made by themselves, or in ravines, or among grasses or bushes. As a rule, they are solitary, and rarely if ever associate in numbers after the manner of other *Canidæ*.

All foxes are more or less insectivorous and frugivorous; but the more tropical forms live on insects more than do those which inhabit temperate climates. All are highly intelligent and famous for cunning. The group is distributed over North America, Asia, Europe, and Africa, but is unknown in South America. The smaller African species are distinguished by the inordinate length of their ears. That foxes constitute at least a subgenus (*Vulpes*) by themselves is certain; and many naturalists regard the group as of generic value.

Probably everybody thinks he knows the fox (*Canis vulpes*) sufficiently well to run no risk of confounding it with any other animal; and if observations were confined to the ordinary foxes of Europe there would be no great difficulty in deciding that they might be included under one name, although even among these there is a considerable amount of variation in size and colour.

When, however, the larger foxes of North America and India are taken into consideration, they will be found to include a number of forms which, while approximating more or less to the British animal, yet differ so remarkably in colouring that it is at first sight hard to believe that they belong to the same species; but all these various modifications pass more or less completely into the colouring of the typical European fox, and are best regarded as mere local races of one widely-spread species.

Including, then, all these races under one specific title, the fox has a more extensive distribution than any other member of the entire family; its range embracing the whole of Europe and Asia north of and including the Himalaya, from Ireland to Japan, and also comprising North America from Hudson Bay

and Labrador to the latitude of Georgia, and Africa north of the Sahara and Sudan. The size of the fox is subject to such an amount of variation that if the length of the head and body of a specimen at one end of the series be represented by 100, that of the one at the other will be equivalent to 170. The length of the tail and ears, however, is much less variable.

The ordinary

English fox (page 366) is of a reddish brown colour above, and white beneath; while the outer surfaces of the ears and portions of those of the limbs are black, and the extreme tip of the tail is white.



THE RACCOON DOG

Occasionally, however, the tip of the tail may be dark grey, or even black. The total length of the head and body may vary from 27 to 46 inches, and that of the tail from 12 to 15 inches.

Welsh mountain foxes are generally greyer than their relatives of the English lowlands, and are not only very fleet of foot, but possessed of wonderful staying powers, so that they often escape after a pursuit of five or six hours, and this after covering some thirty miles of rough, rugged, mountain country. Foxes appear never to have been indigenous to Anglesea. A few pairs have from time to time been introduced from the mainland, but were always killed off by the inhabitants.

The hill fox of Cumberland and Westmorland, commonly known as the "greyhound fox," is a taller and more leggy animal than the ordinary lowland breed. Whether the Welsh or the Lakeland mountain fox is entitled to rank as a distinct local race requires further consideration.

In Southern Europe black-bellied foxes (*C. vulpes melanogaster*) are the prevalent type, and in some degree connect the ordinary form with the Himalayan race (*C. vulpes montanus*), which has a somewhat similar type of colouring, and is a paler animal than the English fox. In its long winter dress the Himalayan fox, generally smaller than the English, is strikingly handsome, with the fur of the back varying from chestnut to dull rufous, more or less speckled with yellow, to a dark iron grey. Frequently there is a dark transverse stripe across the shoulder, bordered with buff patches in front and behind; while the hind parts of the back and thighs are greyer and more speckled with white, the sides paler, and the under parts varying from cream-colour to nearly black. The throat and chest, with the exception of a white spot in the centre of the latter, are frequently darker than the under parts of the body, in which the dusky area may be confined to a streak along the middle.

Like the English fox, the outer sides of the ears are black, and the tip of the tail is white; but the limbs have little or no black, and the colour of the tail is greyish, with a more or less marked rufous tinge. The face is rufous, with a black spot below the eyes, and the cheeks are whitish. Very different is the appearance of the animal in summer, after the loss of its long winter coat, when the dark under-fur communicates a greyish brown tinge to the back; while the sides are paler, and the under parts nearly white. This race is found in the Western Himalaya, from Nepal to Gilgit.

In the higher Himalaya, Tibet, and probably Afghanistan, however, it is replaced by another and larger variety which extends over a considerable portion of Central Asia. This large Central Asian fox (*C. v. flavescens*) is paler-coloured and yellower, as a rule, with a very thick fur and a superb brush. The Japanese fox (*C. v. japonicus*) is somewhat variable in colour, but has been declared to present no points of specific distinction; and the same holds good of the foxes of Arabia, Siberia, and China. The North African fox, which has also been considered a distinct species, may likewise be regarded merely as a local race (*C. v. aegyptiacus*).

The North American representative of the species (*C. v. fulvus*), locally known as the red fox, in order to distinguish it from the very different grey fox, is usually of a reddish yellow colour, with the hind part of the back grizzled, the throat and more or less of the under parts white, the outer surfaces of the ears black, and the tail, except at the white tip, with black extremities to the hairs. A colour phase of this race known as the cross-fox is, as its name implies, characterised by the presence of a transverse dark stripe across the shoulders, and of another running down the middle of the back. The tail is darker than in the ordinary red fox, while the legs, muzzle, and under parts are nearly or completely black.

The beautiful silver fox and the black fox, the fur of the latter of which is so highly valued, are respectively grey or either nearly or entirely black, with the exception of the tip of the tail and the extremities of the longer hairs of the body, which are white. It is these white tips to the hair which give the beautiful silvered appearance to black fox skins. Black and silver foxes are the black and grey phases of the red fox, the range of which extends from northern North America to Georgia. Slightly different races of the fox respectively inhabit Nova Scotia and Newfoundland.

Although the fox is by no means averse from taking possession of the deserted burrow of a rabbit or a badger, it generally excavates its own "earth," in which it spends a considerable portion of its time. As all hunters know, however, foxes frequently prefer to live out in the woods, those with a northern aspect being avoided. Sometimes these animals will select a thick hedgerow or a dry ditch, and I have known them resort to the tall tussocks of coarse grass in swampy meadows as a resting-place; they have also been found in straw-ricks, where it is on record that in one instance

the cubs have been born. The breeding-time is in April, and the usual number of young in a litter is from four to six.

The prey of the fox consists, writes Prof. T. Bell, "of hares, rabbits, various kinds of ground birds, particularly partridges, of which it destroys great numbers, and it often makes its way into the farmyard, committing sad havoc among the poultry. It has been known not infrequently to carry off a young lamb. When other food fails, however, the fox will have recourse to rats and mice, and even frogs and worms;

while on occasion beetles are largely consumed, and, on the seashore, fishes, crabs, and molluscs form a part of its diet. Carrion seems never to come amiss; while the old story of the fox and the grapes alludes to the fruit-eating propensities of these animals."

The usual cry of the fox is a yelping bark. The well-known scent is secreted by a gland beneath the tail. The cunning displayed by English foxes in escaping from hounds is proverbial, and probably attained its present development as the result of the inherited experience of many generations.

That the fox is an ancient inhabitant of the British Islands is proved by the occurrence of its remains in caverns in company with those of the mammoth; while a skull has been dug up from the sands at the top of the Red Crag of Suffolk.

R. LYDEKKER



THE FOX

STORIES OF THE FOX

No animal better lives up to his reputation than the red rover of the woods. He is the boldest, as well as the most skilful and most cunning, of all the creatures of the countryside. As a robber of other people's hen-roosts, he is a most entertaining ruffian. Think of the superb impudence of a fox which robs the poultry yard of the first whip of a crack pack of hounds! It happened within the experience of the writer, who occasionally passed a day at the kennels in question.

"There's been a big dog fox round here in the night," said the head man, as he led the way close beside the high-railed wall shutting off the kennels from the rest of the field. Afterwards came stories of raids upon the fowls and ducks which had been wont to nestle under the protecting influence of one of the best packs of hounds in England. The first whip was right; the big dog fox was at work, supping and breakfasting on the poultry, which were separated only by a wall and paddock from the hounds. That, surely, was the very height of vulpine audacity. The fox was sharp enough to know that the hounds were prisoned o' nights, and that the premises built for their accommodation might with impunity be raided between sun-down and sunrise.

The sequel delivers the fox into the hands of his critics. Says one of them: "The animals unite such ignorance with such apparent knowledge, such stupidity with such cleverness, that in our estimate of them we are likely to rate their wit either too high or too low. With them knowledge does not fade into ignorance, as it does in man; the contrast is like that between night and day, with no twilight between. So keen one moment, so blind the next!" This same fox, which had humour enough thus to carry the war into the enemy's camp, was himself trapped within pistol-shot of the kennels, and the writer was taken to see him chained and crestfallen. For once, and perhaps only once, that pack hunted a bagged fox.

There was once a curious scene on a pretty estate five-and-twenty miles from London. The owner does not preserve birds in the ordinary sense. He specialises in pheasants, of which he has representatives of pretty well every species under the sun, keeping them in large aviaries. One morning the owner observed near his pheasantry what he took to be newly-made rabbit-holes. "Rabbits will be followed by vermin, which in time will attack my pheasants," he said. "Bring out the ferrets, and we will clear out the lot while the mischief is young."

Three ferrets were fetched, and one was turned down. It did not return, and a second was sent in. Neither

did this one come up. The third ferret, a well-proved and specially staunch brute, was then loosed. He returned very quickly, with the flesh from one side of his face missing. At his heels came not rabbits, but three foxes! Now, when a valuable collection of birds is at stake, and a man who no longer rides to hounds is there with a double-barrelled gun in his hand, and a second ready in the possession of his henchman, it requires no impossible stretch of imagination to guess the sequel.

Fox cubs are pretty, merry little things, and not a few are kept in captivity—and these not of the species which Leadenhall Market occasionally supplies by the crate-load. But the tame fox has a habit of forgetting that he is tamed. The latent passion for freedom in the end asserts itself, and Reynard makes a bid for freedom, if loose, even though he has to bite his way



FOX AND VIXEN

past his master. The Dukes of Richmond have reason to remember the power of a fox's jaws. It was the fourth Duke of Richmond who died of a fox-bite. Singularly enough, he had always ridiculed the possibility of hydrophobia. He had been bitten a hundred times by dogs, he said, and had seen many others bitten, but had never known anything more than temporary discomfort to result.

But when, as Governor-General of Canada, he was visiting an outpost of the upper provinces, he interfered to save a tame fox which was being assailed by a dog, and was bitten by it. He thought no more about it for some time, but one night he turned ill at dinner. "I don't know how it is," he said to his aide-de-camp, "but I cannot relish my wine to-night as usual, and I feel that if I were a dog I should be shot as a mad one." Next morning he was feverish and ill, and a day later he could not face water, not even to moisten his hands and face with a damp towel. In order to carry him swiftly home, a river voyage by canoe was decided upon. On reaching the water's edge the duke was seized with violent paroxysms, but with desperate courage he forced himself to go, saying, "Charles Lennox was never yet afraid of anything."

The boatman pulled out into the stream, but the duke was seized with further spasms, and implored his crew to return to land. Reaching the bank, he rushed wildly away into the woods. Horses were obtained, and he spurred madly on, anywhere so long as he might get farther and farther away from the water. He was carried to a farm, but even here he could not rest, begging to be carried still farther from the river. His wish was met, and he was transferred to a barn, where he died in great agony, a victim to the very malady in whose existence he had so steadfastly refused to believe.

Happily, the taming of foxes rarely brings consequences so tragic as the foregoing. Very often, however, the keeping of a semi-domesticated fox leads to diverting results. Some years ago the Kildare Hounds drew a covert near the River Liffey, found in due course, and hunted the fugitive fox for a few minutes, when he ran to a cottage, and claimed sanctuary. Nor was his claim disregarded, for the owner of the cottage recognised in the quarry a fox he had rescued from drowning as a cub. In its new home it had become quite domesticated, till some nomadic impulse, a few weeks before the day of the hunt, had led it to forsake the haunts and ways of civilisation, and to join its wilder brethren in gorse, shaw, and spinney.

Another of the wily ones was a tame fox kept by Captain Bowen Davies, M.F.H., who housed a fox for some months at his kennels. When the adult fox grew restless, and pined for liberty, the M.F.H., possibly not without some thought of future runs, turned his ruddy friend loose. He soon had cause to repent. Like the fox which the writer knew, it raided the master's fancy poultry, but with an audacity and assiduity such as no wild fox had ever previously displayed. Indignant at such base ingratitude, the captain took a few couples of hounds to a certain covert in which he had reason to believe the renegade would be concealed, and soon had them on the line in full cry. Suddenly, however, the "music" ceased, and the owner, who was on foot, plodded on, expecting to find the sport finished. To his intense surprise, things had taken quite a different turn. Instead of finding the fox in fragments, he discovered it in the midst of the hounds, leisurely returning towards him, whisking his brush, and evidently on the best of terms with his former pursuers. Brer Fox, whom "Uncle Remus" has immortalised, never did anything better than that; indeed, invincible Brer Rabbit would have been puzzled to invent a better way out. Brer Fox in real life is a smarter animal than "Uncle Remus," in his passion for Brer Rabbit, will allow.

The tale of Brer Fox and Sis Goose comes to mind as one reads Mr. Richard Kearton's story of the man in the north of England whose flock of geese suffered severely on a certain fox-infested moor. There was no helpful Brer Rabbit to devise a way of escape for the geese, so the farmer had to cudgel his own wits for a means. The plan he hit upon had the advantage of novelty;

he tied a small bell to the neck of his gander, in the hope that its tinkling would keep the foxes at bay. And so it did for a while, the foxes being thoroughly puzzled, if not alarmed. But immunity was not lasting. The foxes, thinking the thing out, concluded that the mysterious bell was harmless. And the next time they made a raid, after long abstention, it was the belled gander itself which they took.

That stroke of impudence, however, is not very different in principle from the way of the fox with a baited trap. By some marvellous instinct, many foxes detect the trap as they detect the hidden danger in poisoned meat; but there are foxes which do allow themselves to be trapped, and still others which, lacking the wisdom of their fellows, fall victims to "doctored" bait. But a fox before a trap, if watched, may be seen to hesitate long and anxiously. He knows danger lurks in the device, and waits and waits, until hunger impels him to go for it with a rush—and get caught.

Let us, however, consider his skill as well as his impudence and rashness. A specially good example places us under obligation to Charles St. John, who, hiding in a plantation for the chance of a shot at a stag,

witnessed the following bit of strategy on the part of a fox. "Just after daylight," he writes, "I saw a large fox coming quietly along the edge of the plantation in which I was concealed. He looked with great care over the turf wall into the field, and seemed to long to get hold of some hares that were feeding in it, but apparently knew that he had no chance of catching one by dint of running. After considering for a short time, he seemed to have formed his plans, and, having examined the different gaps in the wall by which the



A FOX AT REST AMONG LOW SCRUB

hares might be supposed to go in and out, he fixed upon the one that seemed the most frequented, and laid himself down close to it in an attitude like a cat watching a mouse.

"He first, with great care and silence, scraped a small hollow in the ground, throwing up the sand as a kind of screen between his hiding-place and the hares' mews. Every now and then, however, he stopped to listen, and sometimes to take a most cautious look into the field. When he had done this, he laid himself down in a convenient position for springing upon his prey, and remained perfectly motionless, with the exception of an occasional reconnoitre of the feeding hares. When the sun began to rise, they came one by one from the field to the cover of the plantation. Three had already come in without passing his ambush. One of them came within twenty yards of him, but he made no motion beyond crouching still more closely to the ground. Presently two came directly towards him. Though he did not venture to look up, I saw by an involuntary motion of his ears that those quick organs had already warned him of their approach. The two hares came through the gap together, and the fox, springing up with the quickness of lightning, caught one, and killed her immediately."



HOOKER'S SEA LION

"... This species is subject to great variation in colour, some specimens being greyish, while others have a more or less brown tinge."



WHITE-NOSED COATIS

"Coatis go about in small troops, comprising from about eight to twenty individuals, and are mainly arboreal. Their food includes fruits, young birds, eggs, lizards, and insects"



EUROPEAN SQUIRRELS

This species of squirrel is mainly diurnal and arboreal in its habits, seldom descending to the ground, and, when aloft, leaping from bough to bough with surprising agility."



FLYING SQUIRRELS

"They are all exclusively nocturnal in their habits, and mainly inhabit forest regions, although one may frequent rocks alone. When leaping from tree to tree, they utter sharp, piercing cries."

THE GREY FOX

If one fox is clever, two foxes ought to form a strong combination; and that is the case. A neat plan was worked out by a brace of foxes which were watched on a high rocky hill, from which the hares nightly took their way to the plain below. Down this hill ran two channels or gullies which the rain had worn. Near one of these gullies a gunner and his assistant placed themselves in the hope of shooting a hare or two as they descended for their evening meal. Presently a fox descended, quickly followed by another. After playing together for a little, the pair parted. One concealed itself under a large rock at the bottom of the channel, whilst the other returned up the hill. Very soon this one came back, chasing a hare before him.

As the hare was passing the stone where the first fox lay concealed, he sprang out and tried to seize her, but missed his aim, and the hare got away. The chasing fox then came up, and finding that his expected prey had escaped through his confederate's want of skill, attacked the latter, and the pair fought with so much animosity that the men who were watching were able to approach unobserved and despatch them both.

There is no doubt that the fox exercises a like hypnotic influence over certain of his victims to that wielded by the stoat. A "Times" correspondent witnessed an example of this singular power one winter's afternoon near Brockenhurst. A rabbit sat facing a bright sun, its attitude strange and cramped. Looking to his right, the watcher saw a fox stealing upon it. This continued while the man walked some thirty yards nearer. The fox was within six or seven feet of the rabbit when apparently it scented the presence of man, for, turning round, it bounded away. The rabbit hobbled off, its limbs stiff, its back rigid, and looking completely hypnotised. "It was ordinary hypnotism, not catalepsy, since it was evidently held by the fox's odour before. . . . Doubtless, the difficulty of finding food had made the fine old dog-fox so powerfully hypnotic. I fancy its smell, though not very strong, came subconsciously to the rabbit's nose, and fettered it to the spot." Chance alone prevented the rabbit from fulfilling its destiny.

With all the skill he displays in securing food, perhaps the most subtle part of the fox's finesse comes out in his avoidance of man and hound. Some of his devices would do credit to the imagination of a writer of fiction. Despair is a keen driver, and before it the fox will take refuge in drawing-room or chimney without hesitation. The working of the vulpine mind is perhaps better seen in methods of escape deliberately chosen. There was calculation in the trick of the fox which, when hunted from the plantations of Woodhouselee, or other covert on the south-east side of the Pentland Hills, frequently directed his flight towards the romantic fastnesses of Dryden or Hawthornden, on the banks of the Esk.

Invariably hounds lost scent of him at one particular spot on the margin of the river. This is a place known as Roslin Linn, where huge blocks of stone interrupt and narrow the current. Here the fox always seemed to take to the stream, though what became of him afterwards not the wisest head in the hunt could determine. At length, when the field, discomfited as usual, came up, a collier cutting broom on the bank,

was espied immediately above the mysterious spot. He was bribed to point out the fox's retreat. This was none other than one of the largest stones, which stood in the centre of the whirlpool. Upon this stone the fox lay flat, the tone of his fur so nicely harmonising with that of the stone that, but for his base betrayal, he might never have been discovered. He was now driven from his hiding-place and killed. He had been seen to play the same trick several times before, but previous observers had been sufficiently good sportsmen not to divulge his secret. Now that he had been slain, they told how they had seen him make for this refuge, and with what care the wily beast had noted the direction of the wind.

A friend of the writer witnessed, a year or two ago, a wonderful piece of skilful manoeuvring by a hunted fox in Yorkshire. When it came up it was well ahead of the hunt, but its condition showed that it had covered some miles since quitting its earth. Without noticing the onlooker, it entered a field of potatoes. These were stacked in "pies," as they are called—heaps three feet high, covered with soil and straw. The pies ran in a chain along one side of the field, and were from ten to fifteen feet apart. To obliterate his scent, the fox took flying leaps from heap to heap, right across the field. It did not touch the ground again until the last heap had been utilised. When the hounds came up, they paused at once, and before they got on the scent again the fox had had a long enough start to make certain of his safety.

E. A. B.



GREY FOXES

THE GREY FOX

A very different animal from the American race of the common fox is the grey fox (*Canis cinereo-argen-*

tatus, or *C. virginianus*) of North America; so different, indeed, that it is assigned by many naturalists to a separate group (*Urocyon*). It is a considerably smaller animal than the average European fox, and characterised by the grizzled grey colour of the top of the head and the upper part of the body, in marked contrast to which is the rufous tint of the fur of the sides of the throat, body, and limbs. The tail is dusky above, and chestnut below, with its extremity dark, and a dark patch near the root, connected with another dark mark running along the back. The chin is black, as is a spot on each side between the nose and the eye; the outer surfaces of the ears are rusty red; the middle of the throat is nearly or quite white; while the under parts of the body are yellowish white. This fox ranges from the United States to Central America.

Dr. Ellzey, when contrasting the habits of the grey fox with those of the American race of the red species, observes that the two animals differ very widely. "The reds are bolder in pursuit, and hunt over a much greater territory than the greys. Whether the greys ever climb trees in pursuit of prey I am uncertain, but they take to a tree as readily as a cat when run hard by hounds. I think it nearly certain that they climb for persimmons and grapes. Red foxes never climb trees in any circumstances; when hard run they go to earth.

"Grey foxes run before hounds only a short distance, doubling constantly and for a short time, when they either hole in a tree, or climb one. Very commonly they run eight or ten miles away, and then run back in a parallel course. I have known them to run

the four sides of a quadrilateral, nine or ten miles long by about two miles broad. It is doubtful whether a first-rate specimen of the red fox, taken at his best in point of condition, can either be killed or run to earth by any pack of hounds living, such are his matchless speed and endurance. It is but a sorry pack which fails to kill or tree a grey fox in an hour's run. The young of the grey fox closely resemble small, blackish puppies; those of the red fox are distinctly vulpine in physiognomy when only a few hours old."

THE KIT FOX

The smallest and prettiest of the North American species is the kit fox (*Canis velox*), which derives its Latin epithet from its extraordinary fleetness. In this fox the length of the head and body is only 24 inches, and that of the tail, without the hair, 9 inches. The species is characterised by the shortness and stoutness of its limbs, standing relatively lower than the common fox, and also by the bushy tail being less than half the length of the body. The thickly furred ears are also relatively shorter than in the common fox. Other distinctive characters are the length and abundance of the under fur, which is often visible externally, and also the long hairs clothing the soles of the feet. In colour the kit fox is variable, some specimens having the back and tail dark grey, mingled with black and white hairs, the tip of the tail black, the cheeks, shoulders, flanks, and the outer surfaces of the limbs rufous, and the under parts white.

The kit fox is confined to North-Western America, where it inhabits open treeless districts, constructing its own burrows in the ground. It was formerly abundant on the plains of Columbia, and also in those lying between the Saskatchewan and the Missouri, but of late years it has considerably decreased.

THE ARCTIC FOX

Widely different from all the other species is the Arctic fox (*Canis lagopus*), characterised by the difference between its summer and winter dress (p. 115), as well as by certain peculiarities in its form and habits. This species, which appears to inhabit nearly the whole of the known Arctic lands, descending in America to latitude 50°, and in the Old World to 60°, has a less pointed muzzle, and much shorter and more rounded ears than any other fox, while the hind parts of the cheeks are bordered with a kind of ruff of long hairs, and the soles of the feet covered with a thick coat of woolly hair, which is most developed in winter.

In the summer dress the hair is of moderate length, and frequently of a brown or dull rufous colour on the head, back, outer sides of the limbs, and tail, the under parts being yellowish white. The under fur is bluish grey, and the roots of the long hairs are also of the same tint; and when this bluish grey extends farther up the hairs than usual the general colour of the fur is of the same hue. In other cases the whole of the upper parts and the outer sides of the limbs are bluish grey, while the flanks and under parts are almost white.

With the assumption of the winter dress the fur becomes longer and thicker, and the white hairs which are scattered through the summer coat gradually increase in number, at the same time that the tips of the other hairs become white, until the

whole length of each hair is of that colour. The animal is then completely clad in white, the naked tip of the nose being, however, black, while in certain cases the extremity of the tail may also be black. This winter change of colour, however, is by no means of constant occurrence, grey hairs sometimes largely mingling with the white, while in one phase the prevalent hue of the winter fur is uniform bluish grey.

Moreover, pure white foxes are occasionally to be met with in summer. In Iceland, where the winter is less severe than in the more northerly regions, only the blue phase of the Arctic fox is met with, so that these animals are of nearly the same colour at all seasons. Since in the high latitudes the blue and



ARCTIC FOXES IN SUMMER DRESS

the white phases occur in company, the Arctic fox comes under the designation of what naturalists term a dimorphic animal. The hair clothing the soles of the feet aids the creature in obtaining a sure foothold on frozen snow and ice. During the autumn and winter such of these foxes as inhabit the more northerly districts of Arctic America undertake a southerly migration, keeping as much as possible to the coasts, the length of the migration depending to a considerable extent on whether the line of the coast coincides with the line of march or not. These foxes prey largely upon birds, especially upon various members of the auk family, eggs, and lemmings, and Professor A. Newton surmised that they lay up a store of provisions against the scarcity of winter.

THE DESERT FOX

The desert fox (*Canis leucopus*) of South-Western Asia is considerably smaller than the common fox, the length of the head and body varying from 19 to 22 inches, and that of the tail from 12 to 16 inches. It agrees, however, with that species in having a small white tip to the tail, as it also does in the dark-coloured ears. When the full tints are developed, this fox is more strikingly coloured than the common species, although there is a considerable amount of variation in this respect. When fully coloured, the fur of the back varies from brownish yellow to rusty red, and there is usually a distinct pale patch on each side of the back behind the shoulders, in front of which is a dark transverse stripe across them. The sides are lighter, while the under parts generally vary from slaty grey to blackish, the chin, and generally a spot on the chest, being white. In summer the dark under fur is seen through the ordinary hairs, and the whole colour is greyer, the under parts being then nearly white.

THE CORSAC FOX

This species is found throughout most of the sandy and more or less desert regions on the western side of India, and also extends into Baluchistan, Afghanistan, and probably Persia, Arabia, and other districts of South-Western Asia. It is a desert-hunting species, and in India appears to live chiefly on the gerbils so common in the same sandy regions.

THE CORSAC FOX

In the deserts of Central Asia the preceding species is replaced by the corsac fox (*Canis corsac*), distinguished by its paler colour, white under parts, and the black tip to the tail, the shoulder spots and stripe of the desert fox being also wanting. The two, however, are evidently very closely allied, and may prove to be local races of one species. The range of the corsac extends from the banks of the Volga and the shores of the Caspian Sea to the south-eastern parts of Siberia; while eastwards it is doubtless continued into China, although its limits in this direction, as well as to the north, are unknown. It has been obtained from Amurland. Like the desert fox, the corsac is restricted to open and more or less desert regions.

The corsac preys largely on small rodents, such as field-mice, picas, and the like, and is chiefly nocturnal. It does not appear that it makes a burrow for itself, generally tenanting the deserted hole of a marmot, which it leaves after a time for that of another. The corsac is soon run down by dogs, and when tracked to its lair through the snow in winter is said to remain below, and, rather than bolt, perish from hunger.



THE ARCTIC FOX IN WINTER DRESS

The little-known Tibetan fox (*C. ferrilatus*), from the neighbourhood of Lhasa, is another nearly allied small species, distinguished by the relatively shorter ears being pale rufous instead of dark-coloured, and the tip of the tail white.

THE INDIAN FOX

The pretty little Indian fox (*Canis bengalensis*) is, with the exception of an allied species, the smallest of the true foxes, and familiar to all who have resided in India. It measures only 20 inches from the tip of the snout to the root of the tail, while the length of the tail varies from 13 to 14 inches. The tail is thus shorter in proportion to the head and body than in the common fox, and the limbs are characterised by their slenderness. Although subject to the usual variation characteristic of the foxes, the general colour of the fur of this species is grey, with a more or less marked reddish tinge, there being no cross band on the shoulders, while the tip of the tail is black, and the ears are grey. This black tip to the tail, coupled with the small size of the animal, distinguishes this species from all the other foxes inhabiting India proper.

The Indian fox does not occur westwards of the Punjab nor eastwards of Assam, its reported occurrence in Ceylon being more than doubtful. Its cry is a short, yelping bark, quickly repeated three or four times. It is by no means shy, and I have shot one which walked boldly up to within gun-shot range of my camp. Its food is rats, land-crabs, grasshoppers, beetles, and the like.

On account of not possessing the strong scent of its European relative, the Indian fox is seldom hunted with hounds. But it is frequently coursed with greyhounds, when, from its numerous doubles, it gives a good run; pure-bred English greyhounds, however, are too fleet to yield good sport, and either half-bred or Arabian or Persian dogs are, in consequence, generally employed. According to Dr. Jerdon, when this fox is going slowly or hunting for food, the tail is trailed on the ground; when running, it is stretched out horizontally; while during the doubling it is raised erect. The young are almost invariably four in number at a birth, and are produced during February, March, and April. The Indian fox is easily tamed, and in this state is more agreeable than most other foxes, owing to the absence of odour.

Dr. Jerdon states that "the burrow which this fox makes

has always several openings converging towards the centre, some of them blind, others leading towards a larger central one where the animal breeds. This is often two or three feet below the surface. The burrow is usually situated quite in the open plain, now and then in some thorny scrub."

The hoary fox (*C. canus*) is a still smaller species, inhabiting Baluchistan and the southern parts of Afghanistan, the length of the head and body being only 18 inches, and that of the unusually long tail from 15 to 16 inches. It is distinguished from the preceding species by the more ashy grey tinge of its fur.

HARMSWORTH NATURAL HISTORY

SAND FOXES AND FENNECS

The South African cama fox (*Camis cama*) is the first of a small group of species, two of which are characterised by the extreme length of their ears. The present species is somewhat smaller than the common fox, but has considerably longer ears, and therefore appears to form a kind of transition from the true foxes towards



CAMA FOXES

the fennecs. It is a yellowish coloured animal, with some black hairs mingled with the light fur of the back, a black tip to the tail, and some chestnut splashes on the snout.

The draai, or t'gamma jackal, as the cama fox is called in Cape Colony, is asserted to live on mice, hares, and the young of the smaller game. The name draai (Dutch for "turn") is given to this pretty little species from the swiftness with which it "doubles." When moving, it is stated to carry the tail at right angles to its body in a horizontal plane. Its range extends from the Cape to the Zambesi, and includes Namaqualand and Bechuanaland.

The pale fox (*C. pallidus*) may be distinguished at a glance from the cama, not only by its much smaller size, but also by its longer ears and the thinness of its tail. The general colour is pale yellow, with a faint tinge of red, the tail having many black hairs among the lighter fur, a small dark spot on the upper surface near the root, and a small black tip. In its smaller size and longer ears, this species approaches still more closely to the fennecs. The pale fox is a native of Dongola and Somaliland.

Rüppell's fox (*C. famelicus*) is distinguished from all the species hitherto noticed by the great length of its ears, although these are proportionally smaller than in the true fennec. It is a smaller animal than the

pale fox, the length of the head and body being about 19 inches, and that of the tail, 9½ inches; while the ears measure just over 3 inches in length. This fox has a fawn-coloured head, reddish back, shoulders, and tail, greyish sides, and nearly white under parts.

It has an unusually wide distribution, ranging from the Algerian Sahara, Kordofan, Nubia, and Egypt, through Asia Minor and Palestine to Persia and Afghanistan. In Western Africa it is replaced by the closely allied *C. dorsalis* of Senegal.

The smallest representative of the genus *Canis* is the pretty little North African fennec (*C. zerda*), in which the total length of the head and body is only just over 15½ inches, the tail measuring 6¾ inches, and the ears being at least 3 inches in length, and sometimes even more. The ears, being wide in proportion to their length, are of enormous size compared with the head, and thus communicate a remarkable physiognomy to the animal (p. 367). The general colour of the fur of the upper parts varies from pale fawn to buff, the under parts being white, and the tip of the tail black; but there may be black markings on the upper part of the latter near its root. On the forehead and round the eyes the fur is nearly white; while the outer surfaces of the ears are rufous, and their inner margins have some long and nearly white hairs.

Sometimes there is a black mark in the middle of the hind part of the back.

The fennec is confined to Northern Africa, ranging from Nubia to Algiers, and occurring

over the whole of the Sahara. It is essentially an animal of the desert, with the sands of which its pale colouring is in complete harmony, and is mainly nocturnal in its habits. It makes a burrow, generally situated in the neighbourhood of the tufts of low plants growing here and there in the desert, these plants rendering the soil more coherent, and therefore easier to excavate. The inside of the burrow is lined with feathers, hair, and soft vegetable substances, and is remarkable for its cleanliness. The burrow is made with wonderful rapidity—so quickly, indeed, that the animal seems to sink into the ground as though it were diving into water; and when hunted the creature often manages to escape by thus burrowing.

During the day the fennec reposes in its burrow, with its head curled up beneath its bushy tail, and only the ears exposed. At the slightest sound or movement, however, it is on the alert; and, when thus disturbed, it utters a slight whimper, and soon endeavours to dispose itself again to slumber. At sunset the fennec leaves its burrow, and makes for its drinking-place; but instead of going straight across the sand-dunes, it seeks the protection of such ravines and hollows as there may be. Around the drinking-places the moist earth is covered with countless impressions of its feet. After having satisfied its thirst, the

THE DHOLES

fennec sets about seeking its food, which may be jerboas, small birds, lizards, or fruits. The burrows are generally near together, so that fennecs live in small colonies or companies. According to native reports, the young are born in March, the number in a litter being three or four. So distinct is this species that it is regarded by many naturalists as representing a subgenus by itself, under the name of *Megalotis*.

THE DHOLES, OR ASIATIC WILD DOGS

The Siberian wild dog (*Canis alpinus*) belongs to a small group of Asiatic species, distinguished from other representatives of the *Canidae* by the loss of the last molar tooth on each side of the lower jaw, so that the total number of teeth is forty instead of forty-two. The group is further differentiated by the shorter muzzle and the slightly convex profile of the face. On account of these and other points of difference—more especially the presence of either twelve or fourteen teats, instead of the usual ten—these species are frequently referred to a distinct genus, under the name of *Cyon*, and have certainly considerable claim to such distinction, more especially as they appear to be the Asiatic representatives of the African hunting-dog, to which they are allied by the characters of the skull (p. 478). Here, however, they are classed as a subgenus of *Canis*.

Another distinctive feature is the presence of long hairs between the pads of the feet. These wild dogs are in the habit of hunting in large packs, and are noticeable on account of their courage and handsome appearance, the tail being bushy and equal in length to about half the head and body.

Since there is no doubt that these are not the ancestral stock of any domesticated dogs, the name "wild dog" is, to a certain degree, a misnomer.

The Siberian wild dog is an inhabitant of Northern Asia, extending from Eastern and Northern Siberia into the Altai district, and probably still further south. Although closely allied, it may be distinguished from the following species by the fact that its molar teeth, especially those of the upper jaw, are of larger size.

Like its southern cousin, the Siberian wild dog is subject to seasonal and individual variations in the colour of its fur. In summer it is generally of a foxy red colour, becoming darker on the back and lighter on the under parts and the inner surfaces of the limbs. Some skins, however, are characterised by their long and woolly hair, of which the colour may be white, or yellowish white, and these may be presumed to indicate the winter dress.

This dog is a forest-loving animal, but occasionally appears on the open steppes. It is locally distributed; and while in some districts it preys largely upon deer, in others it is in the habit of hunting ibex. In the Altai these dogs go in troops of from ten to fifteen, or more, led by an old male; and when they hunt deer they ordinarily pursue hinds or young animals. So incessant is their persecution of the deer that they will sometimes cause them to desert certain localities. This happened in the valley of the Irkut in 1859.

The Indian wild dog, or dhole, may be regarded as a local race of the under-mentioned Malay species, with the name of *C. sumatrensis deccanensis*. As in the last, the general build is more jackal-like than wolf-like, this being especially shown by the comparative shortness of

the legs. It agrees with the Siberian species in the length of the fur, and in the presence, at least in Himalayan examples, of a thick and woolly under fur. The general colour of the fur of the upper parts is rusty red, varying in some specimens to rufous, or even light brownish grey, the under parts being paler. The end of the tail is black, but its extreme tip may occasionally be whitish. The young are of a uniform sooty-brown colour. One specimen had a length of 37½ inches, exclusive of the tail; the latter measuring 14½ inches with, and 8 inches without, the hair.

It is found throughout the forest-clad portions of the Himalaya, from Kashmir to Assam, and in Gilgit, Ladak, and Eastern Tibet. Southwards of the Himalaya, it inhabits the larger forests of India, although unknown in Ceylon.

In inhabiting alike the forests of peninsular India and the forest-clad regions of the Himalaya, as well as the treeless districts of Tibet, the Indian wild dog presents an instance nearly analogous to that of the lynx. Mr. Brian Hodgson, who alludes to the animal by the Himalayan name of buansu, states that although the Indian wild dog is "not deficient in speed or power of leaping, yet his movements all appear to be heavy, owing to the measured uniformity of his pace. He runs in a lopping, long canter, is unapt at the double, and upon the whole is somewhat less agile and less speedy than the jackal, and very much less so than the fox.



SIBERIAN WILD DOGS

The wild dog preys both by night and day, but chiefly by day. Six, eight, or ten unite to hunt down their victim, maintaining the chase by the powers of smell rather than by the eye. The buansu does not burrow like the wolf or the fox, but reposes and breeds in the recesses and natural cavities of the rocks."

After stating that the number in a pack may occasionally be as many as twenty, Dr. W. T. Blanford observes that these wild dogs "live principally upon deer of various kinds and wild pigs in India, and on wild sheep and antelopes in Tibet. Many sambar and spotted deer are killed by them, whilst sometimes nilgai and Indian antelopes fall victims. Wild dogs avoid the neighbourhood of man, and consequently but rarely attack domestic animals. Occasionally,

however, they kill sheep, goats, and cattle, and instances are known of their pulling down tame buffaloes. I came across a case myself in the jungles east of Bawda, and was curious to see how so large an animal had been destroyed. There were but a few tooth-marks about the nose and throat, and some of the pack had evidently attacked the buffalo in front, while others tore it open. This is probably their usual way of killing large animals; they have been seen to snap at the flanks of a sambar running."

It has been stated that wild dogs are in the habit of giving tongue while hunting, but the statement is contradicted, although it is affirmed that these animals frequently howl at night. There does not appear to be any authenticated instance of the Indian wild dog attacking human beings. In marked contrast to the wolf and the jackal, it is, if not absolutely untamable, exceedingly difficult to domesticate in any degree, this of itself being a proof that it has nothing to do with the ancestry of domesticated dogs. The young in India are born in winter, although this is probably not the case in the higher Himalaya and Tibet. The number of cubs in a litter is usually from two to four, but six or more have been observed. In the Himalaya, near Simla, a breeding-place was discovered where several females bred in company.

By many writers the wild dog of the countries eastwards of the Bay of Bengal is regarded as specifically

Dr. Blandford gives the length of the head and body of a young male as $32\frac{1}{2}$ inches, and that of the tail 12 inches. This race is found throughout the Malay peninsula, and in the islands of Sumatra and Java, while it has also been reported to occur in Borneo. It is likewise found in Tenasserim, and has been obtained near Moulmein, but it has yet to be determined whether the wild dog of Upper Burma belongs to this or the preceding race, and it may be suggested that in the latter district it will be found that the specimens indicate a more or less complete transition between the two races.

Fossil remains of extinct species of wild dogs are found in the cavern deposits of France, Germany, and Sardinia. These species appear to have been closely allied to the living ones, and afford an instance of the relationship of the present fauna of the East to the ancient fauna of Western Europe.

AFRICAN HUNTING DOG

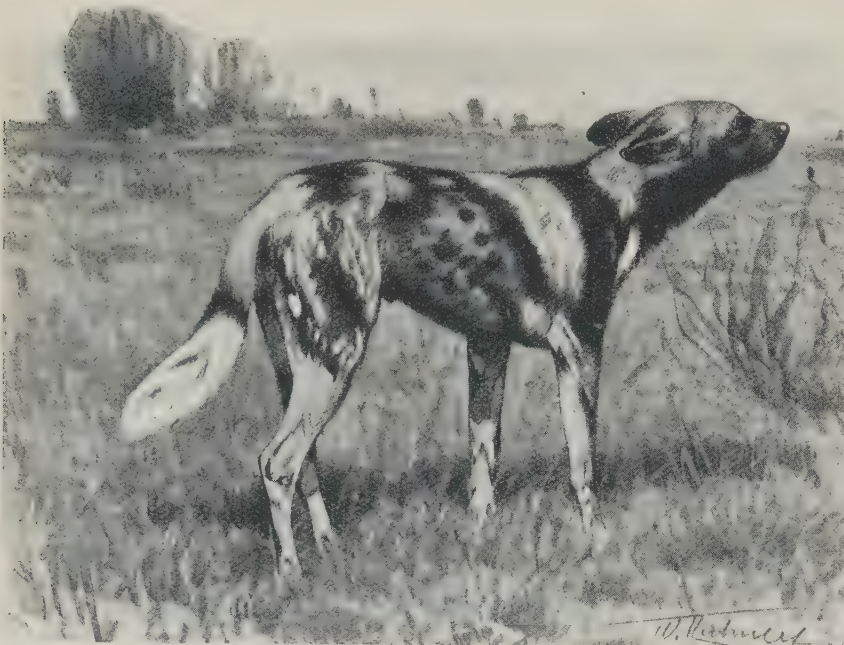
The curious-looking animal commonly known as the African hunting dog (*Lycaon pictus*) differs from all other members of the dog family in having only four toes to each foot, and also in its peculiar irregularly spotted coloration. The number of the teeth is the same as in the wolf; and the skull has also a considerable resemblance to that of the latter, although shorter and broader, while the form of the cheek teeth is

likewise rather different. In point of size the hunting dog may be compared with a greyhound. Its limbs are relatively long; the head is broad and flat, with a somewhat short muzzle, and rather large ears. The fur is rather thin, and coloured with a mixture of black, yellowish ochre, grey, and white, the disposition of the colours varying greatly in different individuals, and the patches or blotches being arranged unsymmetrically on the two sides of the body.

As there are several local races, a definite description of the colouring is difficult; but, speaking generally, the ground colour may be described as ochry grey, upon which are black markings, so that the body and outer sides of the extremities are blotched and brindled with black, mingled here and there with white spots edged with black, the markings being very irregular.

The muzzle is black, and a black stripe sometimes, but not always, passes backwards

from between the eyes and ears and along the neck. The root of the tail is ochry, after which it comes more or less black, while the rather bushy terminal portion is white or whitish. The ears, which are sparsely haired, are more or less black internally, with some white hairs, but externally they are of an ochre colour at the roots, and above this often black. In some cases the front of the fore limbs is more or less marked with black. In the Cape hunting dog a large amount of orange and white occurs on the coat, but in East Africa and Somaliland the general colour is much blacker. On account of such differences of colouring several local races of the African hunting dog have been determined.



THE AFRICAN HUNTING DOG

distinct from the Indian animal. The two are, however, so close that it seems preferable to consider them as belonging to a single species (*C. sumatrensis*), of which the Malay form is the type.

It is smaller and slither in build, and has slenderer limbs than its Indian relative; while the "brush" is smaller, and the hair of the body is short and harsh, and has no under fur. There is also stated to be a difference in regard to the relative length of the flesh tooth of the upper jaw and that of the two molars by which it is followed. In colour this wild dog is of a deep red above, the hairs being scarcely lighter at their roots, while the under parts of the body are whitish.

BUSH DOGS

The range of the hunting dog extends from Somaliland through East Africa to the Cape and adjacent districts. Owing to their peculiarly irregular type of colouring, specimens are particularly difficult to compare with one another, and still more to describe in an adequate manner. No two individuals, even if from the same pack, are precisely identical, and it is only by the average colouring that it is possible to distinguish the local races at all.

As already mentioned, it seems probable that the hunting dog is related to the wild dogs of Asia; but its many peculiarities entitle it to rank as the representative of a genus by itself.

Mr. F. C. Selous once witnessed in Bechuanaland a hunting dog run down a male sable antelope. Along with his comrades, Mr. Selous had been for some time watching the antelope, when suddenly it started off full in their direction. On looking round for the cause of this sudden movement, "we saw that an animal was running on its track, and, although still distant, was overhauling it fast, for the sable antelope, not being pressed, was not yet doing its best, so that when it was about two hundred yards from us, its pursuer, which we now saw was a wild dog, was not more than fifty yards behind us. The noble-looking antelope must just then have seen us, for it halted, looked towards us, and then turning its head glanced at its insignificant pursuer. That glance, however, at the open-mouthed dog thirsting for its life-blood must have called up unpleasant reminiscences, for instead of showing fight, as I should have expected, it threw out its limbs convulsively, and came dashing past us at its utmost speed.

"It was, however, to no purpose, for the wild dog, lying flat to the ground as a greyhound, its bushy tail stretched straight behind it, covered two yards to its one, and came up to it in no time. It just gave the antelope one bite in the flank, and, letting go its hold, instantly fell a few yards behind; at the bite the sable antelope swerved towards us, and upon receiving a second in exactly the same place, turned still more, so that, taking the point on which we stood as centre, both pursuer and pursued had described about half a circle round us, always within two hundred yards, since the sable antelope had first halted. As the wild dog was just going up the third time it got our wind, and, instead of again inflicting a bite, stopped dead and looked towards us, whilst about a hundred yards from it the sable antelope also came to a stand. The baffled hound then turned round, and made off one way, while the sable antelope, delivered from its tormentor, cantered off in another." Mr. Selous adds that this is the only instance known to him of a hunting dog pursuing an animal by itself.

The most remarkable feature about the hunting dog is its superficial resemblance to the spotted hyæna of Africa, this being most noticeable in those races in which the ochre colour predominates, and the dark areas take the form of spots. From this resemblance, which is merely superficial and indicates no sort of affinity between the two animals, the hunting-dog is

frequently termed the hyæna-dog. Although generally nocturnal, the hunting-dog may occasionally be seen during the day.

BUSH DOGS

The bush dog (*Speothos venaticus*) of Brazil and British Guiana is an animal of about the size of a small



BIG-EARED FOXES

badger, differing from all the other members of the family in external appearance, and approximating in general form to the members of that group, although it is not on this ground that it is separated from the genus *Canis*. It is a short-eared, short-legged, and long-bodied animal, with a very deep and rather elongated neck, and of a general dark brown colour. The head, neck, and shoulders differ from the general body-colour in being grey, while the hind quarters, tail, and under parts are nearly black. The great peculiarity of this animal, however, is the fact that it has usually only one pair of molar teeth in the upper jaw, and only two of these teeth in the lower jaw, so that it has fewer teeth than any other member of the family. In addition to this, the lower flesh tooth has no trace of the cusp found on the inner side of the blade in all other dogs; while the heel of the same tooth, instead of being broad and adapted for grinding, is brought to a sharp cutting edge. These features indicate that the bush dog is a more specialised animal than the other members of the family.

For many years the Guiana and Brazilian bush dog was one of the rarest mammals in museums, and even now specimens are very scarce. It was also long the only known living representative of its genus, but in 1906 one of the members of a surveying expedition in the high Andes of Quito, Ecuador, had the good fortune to discover an entirely new kind of bush dog, of which two skins and skulls (male and female) were sent to Paris. This second species, which has been named, after its discoverer, *Speothos riveti*, is even more remarkable than the Brazilian animal, being, it is said, so like a badger or a marten that it is difficult to believe it is much nearer a dog or a fox. As regards coat, it is indeed altogether unique among the *Canidæ*, the fur being short, close, and woolly, like that of a kinkajou or an opossum. The general colour is mouse-grey, but on the back and tail there are a number of longer white-tipped black hairs. The tail, too, is altogether peculiar, being

flattened, with a vane of elongated hairs on each side, and a terminal pencil of black hairs. So aberrant, indeed, is this animal that, in the opinion of its describer, it seems entitled to rank as the representative of a subgenus, for which the name *Microcyon* has been suggested.

Little is known of the habits of bush dogs in the wild state, as they are but seldom seen, and are probably nocturnal. It is stated, however, that these animals are, for their size, very fierce, and hunt in packs. They are found only in the interior of the countries they inhabit, and are said to take readily to water. A specimen kept in captivity was very indiscriminate in its feeding, but preferred animal to vegetable substances. Fossil remains of the typical bush dog are found in the caverns of Brazil, in company with those of a number of strange animals long since passed away.

BIG-EARED FOX

As the bush dog is remarkable for the diminution in the number of its teeth, so the big-eared fox (*Otocyon megalotis*) is peculiar in that it has more than the ordinary complement of these organs. In the lower jaw this animal has invariably four molar teeth, or one more than in any other member of the family, while in the upper jaw it has either three or four of these teeth, whereas in all other living canine animals there are not more than two pairs of upper molars. The total number of teeth is accordingly either forty-six or forty-eight, and no other mammal has four pairs of molar teeth in both jaws. Indeed, the tenrec is the only one in which there are four pairs of these teeth even in one jaw.

The big-eared fox, which is rather smaller than a common fox, comes nearest in external appearance to the fennecs, having enormous ears and a thick bushy tail. The eyes are unusually large, and the limbs are relatively longer than in the fox, but the tail is proportionately shorter. The general colour of the fur is brownish or iron grey, mottled with yellow, the outer sides of the limbs being nearly black, the under parts whitish, and the tail slaty grey, with a black tip, and more or less distinct dark markings on its upper surface.

These remarkable foxes are found in open country, dwelling under or among small bushes, and going about in pairs. Although they are said to stand and watch the hunters by the hour together, they are very difficult of approach. The range of the species extends from Cape Colony along the eastern side of Africa to Somaliland. The bakoor, or basin-eared jackal, as the big-eared fox is called in Cape Colony, is stated to feed almost entirely on white ants. The genus is represented by an extinct species, *O. curvipalatus*, in the Pliocene Tertiary deposits of North-Western India.

EXTINCT DOGS

It has been mentioned that fossil remains of several living members of the dog family have been obtained from the superficial deposits of the countries which they severally inhabit, and it has also been stated that extinct species of wild dog have been found in Europe, while reference to the occurrence of an extinct species of big-eared fox in the Tertiary deposits of India is made a few lines above. A number of extinct species belonging to the genus *Canis* have been obtained from

the Pliocene and Miocene deposits of different parts of the world, but as these are more or less closely allied to living species, they are of no special interest to the evolutionist.

On the other hand, farther back in the geological record there occur, in the Oligocene and Eocene periods, remains of more or less decidedly dog-like animals widely different from living forms. Some of these extinct creatures are, indeed, to a considerable extent, intermediate between dogs and civets, and thus indicate that the civet family is probably derived from the ancestors of the dog family. This enlarges the conception of the relationships of the various groups of modern Carnivora to one another, for it has been already shown that the hyænas are closely related to the ancestral civets (p. 435), while the cats are probably another more or less nearly related side-branch. It thus seems that all the Carnivora with bladder-like tympanic bullæ to their skulls—namely, cats, civets, hyænas, and dogs—have sprung from a common ancestral stock nearly allied to the modern dog. The most civet-like of these intermediate extinct animals are known by the name of *Cynodictis*; they were mostly of about the size of the fox, with teeth numerically the same as in either the latter or the civets, and plantigrade feet.

Far more remarkable, however, is the connection which is shown to exist by these fossil types between dogs and bears, which are now so widely sundered. The connecting type is formed by animals known as *Amphicyon* and *Dinocyon*. Some of these amphicyons, or bear-like dogs, were not larger than a fox, while others must have fully equalled a bear in size.

They differed from modern dogs in having forty-four teeth, owing to the presence of a third pair of molars in the upper jaw, and also in that their feet were plantigrade, like those of a bear; while they had five toes on all feet.

The teeth of these plantigrade dogs were, indeed, essentially those of a modern

dog; but there is a complete transition through other extinct forms to those of the bears. Hence it may be concluded that these plantigrade dogs were not only the ancestors of the modern dogs, but likewise gave origin to the bear family. The dog family is, therefore, the most ancient type of Carnivora now living, and the one which includes the extinct forms from which nearly all the others have originated, while it is the one most nearly related to the extinct creodont Carnivora, which may have been directly descended from mammal-like reptiles (p. 143).

In addition to *Amphicyon* and *Dinocyon*—of which the first is typically a European genus—the Oligocene strata of North America have yielded remains of several other interesting extinct types of *Canidæ*. Among these is *Daphænus*, representing a type which completely died out; while *Proamphicyon* was the ancestor of *Amphicyon*. The genus described as *Protemnocyon* appears to be ancestral to the later *Temnocyon*, which is nearly related to modern forms, and perhaps, by the loss of the last lower molar, to the Asiatic dholes. Possibly, however, this tooth may have been lost and afterwards recovered in the *Canidæ*, although *Temnocyon* stands nearer to the typical forms of *Canis*, both as regards time and the conformation of the tympanic bulla of the skull, than *Protemnocyon*, which American naturalists regard as ancestral, it may be a little off the direct line.



THE GUIANA BUSH DOG

THE BEAR FAMILY

IF one peculiar species now included in the raccoon group be excluded, bears are so different in appearance from other Carnivora that no one can fail to recognise their representatives or hesitate to admit that, so far at least as living forms are concerned, they are entitled to constitute a group by themselves. The number of species included in the family (*Ursidæ*) is comparatively small, and all of them are arranged under two genera, one of which is represented by a single species.

Bears, which include the largest living terrestrial representatives of the order, differ from all the Carnivora hitherto noticed in an important feature connected with the hind part of the under surface of the skull. In the preceding families the so-called tympanic bulla at the base of the internal portion of the ear forms an inflated bladder-like capsule divided internally by a larger or smaller bony partition; but in the bears—as well as in the raccoons and weasels—this bulla is depressed and flattened, with no trace of an internal partition; while its aperture leading to the external ear is produced much farther outwards.

The degree of inflation of the bulla is doubtless associated with the acuteness of hearing, Carnivora with the biggest ears, like the North African fennec and the South and East African big-eared fox, having larger bullæ than their small-eared relatives. Bears are notoriously deficient in the sense of hearing, and probably raccoons and weasels are also less acute in this respect than cats, civets, and dogs. Although many of the Carnivora with inflated bullæ have, like the cats, comparatively small ears, no bear, raccoon, or weasel has these organs of very large dimensions, while in some instances they are almost absent.

All the members of the bear family are characterised by their heavy and massive build, thick limbs, extremely short tails, and the presence of five toes, armed with powerful claws, on both the fore and hind feet. When walking, the whole sole of the foot is applied to the ground, so that the impression of a bear's foot represents a considerable superficial resemblance to that of a man. The claws of the feet are incapable of being retracted, and are well adapted for digging, although none of the family is in the habit of constructing burrows after the manner of foxes. In most cases the under surface of the sole of the foot is completely devoid of hair, and the ordinary gait is peculiarly slow and measured.

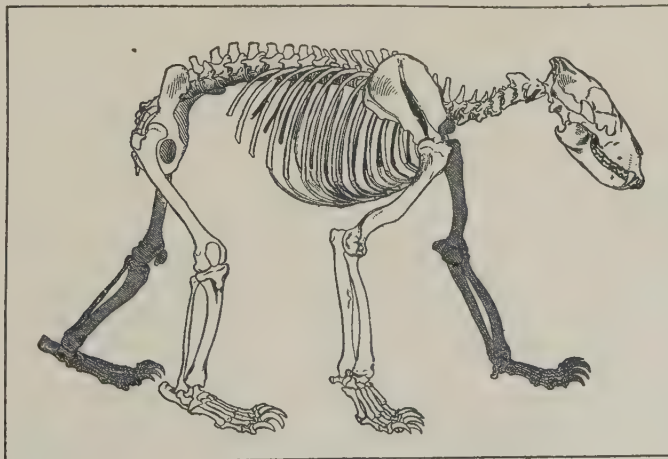
The living species of bears, to which allusion is for the moment restricted, are further distinguished from other Carnivora by the characters of their teeth. They agree with the true dogs in having two pairs of molars in the upper, and three pairs in the lower jaw, but the shape of these teeth is different, the crowns being nearly flat, very broad, and mainly adapted for grinding, while those of the upper jaw are either oblong or square, and therefore unlike the triangular upper molars of the dogs. Then, again, the flesh tooth

in both jaws is very unlike that of the ordinary Carnivora, the upper one being small and having no inner root, and its crown looking much like that of a molar. Similarly, the lower flesh tooth—which is the first of the molar series, while the upper one is a premolar—is very like the two molars by which it is followed. A third distinctive feature is that the first three premolar teeth in both jaws are exceedingly minute, and generally shed when their owner attains maturity.

The peculiar characteristics of the cheek teeth clearly indicate that the food of all bears is very different from that of other Carnivora; and, as a matter of fact, the majority of these animals subsist on a vegetable diet, or on insects, to a much greater extent than on flesh. From their evident descent from dog-like animals, it is clear that the peculiar features of the dentition of modern bears have been acquired, and these animals, so far as their teeth are concerned, may be regarded as a highly specialised type; and the loss of the tail is likewise a specialised feature. On the other hand, in their retention of the plantigrade mode of walking, bears are much more generalised animals than dogs, and in this respect reproduce a feature of the ancestral types from which the two groups have sprung.

The whole of the members of the family present a marked resemblance to one another, so that the characters by which the different species are distinguished are in some instances trivial. Their fur is coarse, long, thick, and shaggy, although it may be short and thinner in some of the tropical species. Except for the frequent presence of a white gorget on the throat, the fur is nearly always of one colour, usually some shade of either brown or black, although it may be grizzled, or even white. The great prevalence of black among the bears is a feature unknown in any other group of Carnivora, and is, indeed, rare among mammals.

Bears have a wide geographical distribution, occurring throughout Europe, Asia, and North America, while one species inhabits the South American Andes, and another the African Atlas Mountains. South of the latter, however, not a single member of the family is to be found throughout Africa. Geologically speaking, true bears—that is to say, those which can be referred to the genera now living—are of comparatively recent origin, none being yet known



THE SKELETON OF A BEAR

before the Pliocene, while they did not become abundant till the succeeding period. This late appearance of bears is in harmony with what has been stated as to their specialisation.

Bears seem to have been originally an Old World group, which made its way into North America at a comparatively late epoch by means of a land-bridge across Bering Strait. After North and South America became connected, about the middle of the Tertiary period, certain species entered the latter country, where there were previously no large land Carnivora of the modern type.

TYPICAL BEARS

With the exception of the Indian sloth-bear, all the living species of bears may be included in the genus *Ursus*, which is characterised by each member having a total of forty-two teeth, when all the small premolars are present, of which $\frac{3}{2}$ are incisors, $\frac{1}{2}$ canines, $\frac{1}{2}$ premolars, and $\frac{3}{2}$ molars on each side. In the adults several or all of the three anterior premolars may disappear from both jaws, although the one immediately behind the tusk may remain longer than the others. The molar teeth are characterised by their crowns being longer than they are broad, the last upper molar being a much elongated tooth, while in the lower jaw the last molar is shorter than the tooth which precedes it.

As a rule, the soles of the feet are naked and the claws are of moderate length and curvature. As in the other genus of the family, the ears are small, erect, and thickly haired; and the pupil of the eye is round. The geographical distribution of the genus is co-extensive with that of the family.

THE POLAR BEAR

Not only does the Polar, or white, bear (*Ursus maritimus*) differ from nearly all other bears in its more or less pure white coat (p. 56), but it is also distinguished from most white mammals in that this livery is retained at all seasons of the year instead of being exchanged in summer for a darker tint. In addition to this distinctive white dress, the Polar bear is characterised by the relatively small size and extremely elongated form of its skull, as well as by the molar teeth being relatively smaller and narrower than in the other members of the genus. The soles of the feet are also

On account of the aforesaid differences, the present species represent a subgeneric group, *Thalassarchus*, by itself, which is regarded by some naturalists as of generic value. The coat of this species may be either wholly white or more or less tinged with yellowish, and it is possible that differences in the colour and texture of the fur may distinguish the numerous local races of the species which have been named on the evidence of skull character.

The Polar bear is found throughout the Arctic regions of both the Eastern and the Western Hemispheres. It is now rare on the south-western coasts of Spitzbergen and Novaya Zemlya, where the ice almost completely disappears in summer. On the northern coasts of America and Asia it is found everywhere, and becomes more and more numerous as we travel northwards. In Labrador, where it is now very rare, there is evidence that it was once comparatively common, and it may have originally extended even into the State of Maine. The bones found in the shell mounds of Goose Island, Casco Bay, Maine, are considered to belong to the present species, and thereby indicate the probability of its range having extended thus far south.

The Polar bear generally lives on such coasts and islands as are surrounded by ice, while it is often found on the ice-fields far out at sea, which form its best hunting-grounds. In Baron Nordenskiöld's opinion it is uncertain whether Polar bears hibernate, although there are circumstances indicating that they probably do. Their disappearance from the more northerly regions in winter may, however, be due to migration, while individuals found in concealment may have been females, which bring forth their young beneath

the snow. Other writers state that in many districts males and young cubs are to be found in active life throughout the winter, but it is possible that in the most northern portions of its range both sexes habitually hibernate.

According to Eskimo accounts, the female bears are very fat at the time they retire beneath the snow. During their extended excursions after prey, the male and the female—the latter generally attended by one or two good-sized young ones—keep each other company. More than these family parties are seldom



THE POLAR BEAR

peculiar in having a certain amount of hair growing on them for the purpose of enabling the animal to have a better grip of the ice. The neck is longer than in other bears, while the ears are unusually small. In contrast to the white coat, the bare portions of the nose and lips are black. The Polar bear is one of the largest members of the group, not infrequently attaining a length of close upon 9 feet, although exact measurements from recently killed wild animals are few.

seen together, unless at places where many carcasses of walruses, seals, or white whales are lying.

The white bear's principal food in winter consists of the flesh of seals and walruses. "There is not the least doubt," remarks Nordenskiöld, "that, along with flesh, the bear also eats vegetable substances, as seaweed, grass, and lichens. The flesh of the bear, if he is not too old or has not recently eaten putrid seal flesh, is very catable, being intermediate in taste between pork

THE POLAR BEAR

and beef. The flesh of the young bear is white and resembles veal." The Polar bear also subsists on the flesh of white whales and other cetaceans. In some districts it consumes a large quantity of fish, more especially salmon. In summer these bears resort more or less completely to a vegetable diet, which includes a large proportion of berries of various kinds.

It seems probable that the accounts given by the older voyagers of the ferocity of the Polar bear were considerably exaggerated, although at close quarters it is a formidable foe. "Unlike its congeners," writes Dr. R. Brown, "it does not hug but bites; and it will not eat its prey till it is dead, playing with it like a cat with a mouse. I have known several men who, while sitting watching or skinning seals, have had its rough hands laid on their shoulders. Their only chance then has been to feign being dead, and manage to shoot it while the bear was sitting at a distance watching its intended victim. Though Eskimo are often seen who have been scarred by it, yet, unless attacked or rendered fierce by hunger, it rarely attacks man. During our last trip to Greenland none of our party saw one; indeed, they are only killed in the vicinity of Diskö Bay during the winter or spring."

The pace of Polar bears is considerable, and they have been known to overtake and kill Indians in fair chase. Their fleetness, of course, depends upon their condition, the thinner they are the greater being their speed. The weight of a large, fat Polar bear is estimated at from 600 to 700 lb.

In the Hudson Bay district the female bears proceed to their winter quarters for the purpose of producing their young at the end of September or beginning of October, and reappear in March, April, or May. The hibernation always takes place some distance inland, and the males accompany their consorts to their resting-places, after which they come back to the coast, where, according to some observers, they hunt throughout the winter. Generally two cubs are produced at a birth, but the number may be sometimes diminished to one, and occasionally increased to three.

R. LYDEKKER

STORIES OF POLAR BEARS

Although stay-at-home zoologists say, and rightly say, no doubt, that the stories of the ferocity of the Polar bear have been much exaggerated, the man on the spot finds the bear a sufficiently alarming foe, even on the unexaggerated facts. The men of the Fram did not expect to meet bears as soon as they did, and, even when aware that the animals were in their latitude, neglected to go adequately armed. Nansen himself turned out without so much as a pen-knife. After one or two experiences, however, the men would willingly have carried with them a whole arsenal of arms, so thoroughly alarmed were they at the audacity and the insatiable appetite of the bears. The biggest fright they had was caused by a little

one-year-old bear. While the crew slept aboard the ice-locked Fram, the bear crept on board by the gangway and pushed aside a box which shut it off from the nine-and-twenty dogs tethered there. It seized a dog and, snapping its leash, carried it far out over the ice and ate it. Its hunger was not satisfied, and, returning, it took a second dog, and after that a third.

At this point Peter Johansen, hearing a disturbance,



POLAR BEARS IN THE LONDON ZOOLOGICAL GARDENS

went on deck, and saw from bloodstains that there had been an enemy among the dogs. Tracks led away from the gangway over the ice, and, with the whole of the remaining dogs in attendance, he set off in pursuit, braver than wise, for he had no gun or other weapon with him. The dogs soon came up with the bear, which instantly showed fight against the whole pack, and challenged the man as well. Johansen ran for the ship, but fell among the hummocks. The bear charged down upon him, and seized him by the right side, growling and hissing as he bit.

Johansen himself writes of his experience in the following words: "What was I to do? I thought it was all up with me: I had neither gun nor knife. But I took the lantern and gave him such a whack on the head with it that the thing broke, and went flying away over the ice. The moment he felt the blow he sat down and looked at me. I was just taking to my heels again when he got up; I don't know whether it was to grip me again or what it was for, but, anyhow, at that minute he caught sight of another dog coming, and set off after it, and I got on board."

But the fight was by no means ended. The yearling bear, which had already supped on two dogs and killed a third, as well as making an attempt upon the life of a man, was still full of battle, and there followed such a wrestling match with the dogs as never was. The whole pack closed about him again as he left the man. Now he would make a rush and get one blow in; but then all the rest would set upon him and jump on his back, so that he would have to turn to defend himself. Then he would spring upon another dog, and the whole pack would be on him again. So the fight went on, backwards and forwards over the ice,

until the ship was neared, where a dog cowered under the gangway, wanting to get on board. The bear made a dash upon it, but now met its fate in the shape of a bullet from the deck.

All this excitement over a "miserable, thin, little one-year-old bear." Let us not too lightly declare, then, that there is naught to be feared from

The white bears all in a dim blue world
Mumbling their meals by twilight.

The bear is absolutely fearless, and though he may be simple game to a man armed with a good breech-loader of the necessary bore, or easily despatched by Eskimos trained to hunt him, he is to any man insufficiently armed as great a source of terror to-day as were his progenitors to the men who first ventured into the frozen wilds in which he makes his home.

Because he is bold and savage in pursuit of food, we are not to assume that he is not also astute. The men of the Fram had a striking example of the cunning of the Polar bear when they set a trap to catch one which they imagined to be prowling round about soon after their adventure with the yearling. When on the way to the ship, the bear was seen to turn its attention to the trap, which had been set high on a sort of gallows to prevent the dogs from falling into it. He looked well at the apparatus, then raised himself cautiously on his hind legs and laid his right paw on the cross-beam close beside the trap, stared for a little, hesitated at the delicious morsel of blubber, but did not at all relish the ugly jaws around it.

Sverdrup was watching from the deck, anxiously expecting every moment to hear the trap go off. But the bear shook his head suspiciously, lowered himself cautiously on to all-fours again, and sniffed carefully at the wire by which the trap was fastened, following it along to where it was made fast to a great block of ice. He went round this, saw how it was all arranged, then slowly followed the wire back, raised himself up as before, with his paw on the beam of the gallows, had a long look at the trap, shook his head again, and then resumed his march to the ship, leaving the bait untouched. His avoidance of the trap, hungry as he was, speaks volumes for the intelligence of the beast, for experience of many traps cannot yet have come to the bears of the Polar regions.

Animal trainers have always declared that bears

in general, and Polar bears in particular, are among the hardest, if not indeed quite the hardest, of animals to train. Stupidity and intractability are the causes to which this "defect" is equally attributed. But it is fairly obvious that not stupidity so much as inherent fierceness is the cause of so many failures.

Yet there must have been mistakes in the treatment of captive bears, for while men have lost their lives in the vain attempt to teach Polar bears to perform, there were recently introduced to a London audience over three-score trained bears of this order, who,

whether they liked it or not, evinced no serious distaste for the part they played in one of the most sensational spectacles seen in a London arena.

All who have hunted them agree in declaring that no other animal shows more striking affection for its young than the female Polar bear. Even the savages who riot in slaughter among the defenceless seals, so that their trade has become one of the scandals of civilisation, cannot help a note of pity as they tell of the slaughter of a bear dam and her cubs. Men not engaged in indiscriminate slaughter are still more impressed by the extraordinary affection which these ordinarily savage beasts display.

A memorable story from the log of Captain Phipps, of his Arctic voyage in the Carcass, serves better than most to bring home this point. As the ship lay ice-bound, three bears, which proved to be the dam and two cubs, were seen advancing over the ice towards a fire which the crew had made on the ice to destroy the blubber of a walrus which they had previously killed. The animals appeared to be ravenously hungry, and, advancing to the fire, drew from the flames such pieces of the blubber as they could reach, and

greedily ate them. The sailors on board threw large pieces of the flesh that were still left, which the dam carried away, and, dividing them, laid them before her young ones, reserving only a small portion for herself.

As the old one carried away the last portion of flesh of which the crew could afford to dispose, the men levelled their guns and stretched the two cubs dying upon the snow. A third shot wounded the mother, though not mortally. It would have drawn tears of pity from anyone possessed of feeling, we are told, to see the affectionate concern evinced by the poor animal while her cubs were in the agonies of death. She was so severely wounded that she could only crawl to the



THE BROWN BEAR CLIMBING

THE BROWN BEAR

spot where they lay, carrying with her the piece of flesh which she had last taken away from the side of the ship. Having torn this asunder as she had torn the others, she laid it before them. When she perceived that they refused to eat, she laid her paws first on the one, and then on the other, endeavouring to raise them up, while she at the same time uttered piteous moans.

When she found that her efforts to raise them were unavailing, she retreated, and, having gone some distance, looked back and uttered deep moans. Seeing that this had no effect in making them follow her, she returned, and, smelling round them, began to lick the blood from their wounds. She retired a second time, and having with difficulty crawled a few paces off, again looked behind her, and stood for some time uttering heartrending moans. Finding that her cubs still did not follow her, she returned to them once more, and, with marks of the utmost tenderness, went round each successively, pawing them. Discerning at length that they were cold and lifeless, she raised her head towards the ship, and "growled a curse" upon the destroyers of her offspring, which they returned with a volley of musket balls, when she fell prostrate between her cubs, and died in the act of licking their wounds.

With such wonderful affection as this, it might be expected that she-bears would have their wits sharpened in the process of protecting their progeny. But as man is the only formidable enemy the bear knows in the frozen wilds, and as he is not frequently on her trail, she is not called upon regularly to exercise her talent in this direction. However, that on occasion the Polar bear is capable of exceptional skill in assisting her little ones, just as she is capable of extraordinary heroism, if that term may pass, in dying with them, the following incident is evidence. It occurs in Scoresby's "Account of the Arctic Regions."

A party of sailors pursued a she-bear and her two cubs over an ice-field. The bear urged her young ones to an increase of speed by running before them, turning round and manifesting, by a peculiar action and voice, her anxiety for their progress; but finding that her pursuers were gaining upon them, she carried or pushed, or pitched them alternately forward, until she effected their escape. The plan of the escape was carefully carried out. The cubs placed themselves deliberately before her, right in her path, in order that

they might receive the impulse. With a thrust of her paws she would project them some yards in front. They then ran onwards until she overtook them, when they alternately adjusted themselves for a second throw until all three were out of danger. Such a method of escape cannot be instinctive; there cannot have been need sufficiently frequently to call it into play. Hence reason seems to be on the side of the man who declares the example to be one of intelligent adaptation to the particular circumstances of the case. With all his skill as a hunter the bear must frequently go hungry in the dark winter night. It is the lean he-bears that are chiefly met then, and these are they, as we all know, which are most to be feared. Many stories are told of the easy way in which a bear, intent upon attacking a man, may be frightened off.

The man who pops a handful of fizzing squibs into the nose of a bear which has thrust its head through his sleeping tent may consider, if he chooses, that he has successfully established the case of the author who favours this appeal to the nerves of the animal. But Nansen's men, when they found a lean and starving he-bear tearing over the snow, nose down, hot upon their trail, found that theory and practice are not invariably reconcilable.

One of the men, remembering his book-lore, suddenly stood forth, threw out his arms, raised himself to his full height, and yelled loudly enough to crack thence which held the Fram so fast. The bear, instead of playing its part and bolting in terror, simply raised its head from the trail, and redoubled its pace towards the three men. It remained for Nansen himself to put a bullet through the marauder. That bear, which was

very lean, was found, when opened, to have in its stomach nothing but a piece of paper in which some of the crew had wrapped up a greasy substance.

E. A. B.

THE BROWN BEAR

The brown bear (*Ursus arctus*) is the typical and best-known representative of the entire group, and is distinguished from the Polar bear, not only by its colour, but also by its larger and wider head, in which the muzzle is shorter, the profile is more curved, and the ears are larger. The neck is also shorter and thicker, the teeth are relatively larger, and the soles of the feet entirely naked (page 368).



BROWN BEAR IN SEARCH OF HONEY

On account of differences in the skull and teeth, and variations in colour, several so-called species, such as the Syrian bear and the snow or isabelline bear of the Himalaya, with a number of American brown bears, have been established on what are best regarded as local races of the present species.

Including these local races, the brown bear may be described as one of the largest species of the genus, furnished in winter with long, thick, shaggy, and soft fur, beneath which is a thick and woolly under fur, the ears being of moderate size, and covered with long hair. The colour is some shade of brown, although subject to great individual and local variation. It ranges from very pale to very dark brown, some of the lighter varieties being almost cream-coloured in certain parts. In certain races the fur has a silvery tinge, owing to the hairs being tipped with white, while some specimens have a decidedly reddish tinge.

In the light-coloured Himalayan race (*U. arctus isabellinus*) the colour deepens with age, this darkening being most developed in old males, which are frequently indistinguishable in colour from the ordinary European form. Young animals have a white collar on the throat, traces of which may often be observed in the newly-grown fur of the adult; and this collar persists throughout life in some of the Asiatic races. The summer coat is much shorter and thinner than the winter dress, and is likewise darker in colour. The claws are of moderate length, and their colour varies from brown to nearly white.

It has been suggested that the generally lighter colour of the Himalayan brown bear may be due to the fact that it inhabits more open ground than the European race; and to this it may be added that the silver-barked birch, among which these bears are so often found, affords another reason why their colour should so generally be comparatively light, as among such surroundings a dark animal would be conspicuous.

It may be, also, that the snow lies longer on the ground in the regions frequented by the Himalayan bear than is the case in the habitat of the European bear. Himalayan bears are decidedly lighter when they issue from their winter sleeping-places than they are later in the season, and as it is at this season that they are usually shot, on account of the fur being in its best condition, the prevalent idea as to their extremely light colour is readily accounted for.

Although, as in the other species of the genus, the males are considerably larger than the females, there is nearly as much variation in point of size in the brown bear as there is in respect of colour. As a rule, the Himalayan race is smaller than the European. Exact measurements of large European examples are not easy to obtain, but some specimens reach at least 8 feet from the tip of the snout to the root of the tail. In the Himalayan race the same dimensions are not generally more than

5 or 5½ feet, but large specimens reach about 7 feet, and one has been recorded of 7½ feet in length and 3 feet 5 inches in height. The tail does not measure more than 2 or 3 inches.

The brown bear may be regarded as an inhabitant of almost the whole of Europe and of Asia northwards of the Himalaya, as well as of Siam and Japan; its former range extending from the British Islands and Spain in the west to Kamchatka in the east. Bears are still found in the Pyrenees, and are comparatively common in many parts of Scandinavia, Germany, Hungary, and Russia. At what date they finally disappeared from the British Isles cannot be determined; but evidence has been adduced to show that bears were still in existence in the eighth century, and in the time of Edward the Confessor the town of Norwich had to furnish annually one bear to the king.

In the Himalaya the brown bear is found from Afghanistan in the west to Nepal in the east. It does not occur in the more or less Tibetan districts of Zaskar and Ladak but extends up the valley of the Indus as far as Gilgit. In the mountains around the valley of Kashmir brown bears were once very numerous, but are now much rarer. When I first knew Kashmir, in 1874, it was no uncommon event in the Tilel district to see several at once, when standing on a mountain ridge, but eight years later I saw very few the whole time I was in the country.

In Kamchatka, where two races of the species (*U. a. piscator* and *U. a. beringianus*) are recognised by some naturalists, brown bears are, or were, extremely plentiful, and attain large dimensions. Of the other Old World



A BROWN BEAR IN THE WATER

racés, the Caucasian bear has been described as *U. a. meridionalis*, the Japanese as *U. a. yesoensis*, the West Siberian as *U. a. collaris*, and the little-known North African as *U. a. crowtheri*. Special interest attaches to the Burmese *U. a. shanorum* as the only race inhabiting the Indo-Malay, or Oriental, region. This race is nearly allied to the one inhabiting Yezo, or Hokkaido, but differs in its inferior size and certain features in the form of some of the cheek teeth.

THE BROWN BEAR



A GROUP OF ALASKAN BEARS

In Europe, at any rate, the brown bear is a comparatively unsociable animal, though not infrequently a male and a female may be seen together, while the females, are, of course, accompanied by their cubs. Their favourite haunts are wooded, hilly districts. In the Himalaya the brown bear is to be found at considerable elevations, in the spring haunting the higher birch and deodar forests, while in the late summer it ascends to the open grass-lands above, where it may be seen grazing close to herds of ponies and flocks of sheep or goats. Both in these regions and the colder districts of Europe and Northern Asia these bears regularly hibernate; and while they are extremely fat at the beginning of their winter sleep, they are reduced to little more than skin and bone at its close.

In the Himalaya the winter sleep lasts till April or May, but varies somewhat in different districts according to the date at which the snow melts. The cubs are generally born during the latter part of the hibernation, and accompany the mother when she issues forth. They are almost invariably two in number, and are born blind and naked, in which condition they remain for about four weeks.

In Europe the brown bear often kills and eats other animals, its depredations extending, it is said, even to cattle and ponies; but in the Himalaya, except when carcasses come in its way, it is almost exclusively an insect and vegetable feeder. There it is fond of the numerous species of bulbous plants growing on the mountains around Kashmir, but it will also descend into the orchards of the upland villages to plunder the crops of mulberries, apricots, walnuts, and the like. On such occasions it ascends the trees readily enough, although by no means such a good climber as its cousin the Himalayan black bear. It seeks for insects by overturning stones. In Kamchatka the brown bear subsists for a certain portion of the year upon salmon.

As mentioned, the brown bear, in common with its relatives, is dull of hearing, and by no means well gifted as regards sight. What it lacks in these respects, however, it makes up for in the great development of the sense of smell. Owing to this deficiency of hearing, a bear can be approached from the leeward to within a very short distance, and the writer has shot many

in the Himalaya with a smooth-bore gun. Care, however, should always be taken to approach a bear from above, as a wounded one rolling down hill on to the hunter is very dangerous. If two bears are feeding together, and one is hit by a bullet, the latter will sometimes turn fiercely on its companion, apparently under the impression that it was the aggressor. In the Himalaya, at least, the brown bear never voluntarily attacks human beings if unmolested, and rarely turns on them when wounded, unless brought to close quarters.

There is little doubt that the current stories of the fierceness of the European bear are exaggerated. In regard to the proverbial "hug," Dr. W. T. Blanford observes that the theory is apparently devoid of foundation. "A bear, from its anatomical structure, strikes round with its paws, as if grasping, and the blow of its powerful arm drives its claws into the body of its victim, causing terrible wounds; but the idea of its 'hugging' appears not confirmed by recent observers."

At the best, a brown bear is uncouth and grotesque in its movements, and in no case is this more marked than when one of these animals suddenly catches a whiff of human scent, and starts off with a loud "whuff" at a shambling gallop. In spite of their uncouthness, however, bears can travel pretty quickly when so minded, although their usual gait is slow and deliberate.

The brown bear is easily tamed, and both in Europe and India is the companion of itinerant showmen, by whom it is taught to dance and go through various other performances. Formerly, native English bears, and afterwards foreign ones imported for the purpose, were kept in England for the purpose of "bear-baiting," and the office of Master of the Bears was a Crown post, while every nobleman kept his "bear-ward." Bear-baiting was continued till the reign of Queen Anne. The well-known bear-garden at Berne, in Switzerland, is doubtless a survival of the mediæval establishments kept up for this so-called sport.

As showing the age to which the brown bear may live, it is worthy of mention that one kept in the garden at Berne survived for upwards of forty-seven years, while it is on record that a female gave birth to young at the age of thirty-one years. From the beauty of their

colour, and the length of their fur, the skins of the Himalayan brown bear, if procured early in the spring, are held in high estimation.

Fossil remains referred to the brown bear have been found in the superficial deposits of Ireland, and bones and teeth belonging to this species occur in the fens, brick-earths, and caverns of England, as well as the corresponding deposits of the Continent.

As regards the brown bears of North America, most American naturalists, who view geographical isolation as indicative of specific distinction, regard all these as representing distinct species, of which quite a number has been named. Treating these as local races of the European species, the first for mention is the Kadiak brown bear (*U. a. middendorffi*), which is the largest of all, and stated to measure 10 feet in length. It inhabits Kadiak Island, Alaska, and is said to be nearly similar in colour to the grisly. Nearly as large is the Yakutat bear (*U. a. dalli*), of the main land, distinguished by its flattened, instead of vaulted, skull.

The Sitka race (*U. a. sitkensis*), of the Sitka coast region of Alaska, is described as smaller than the Yakutat, with cheek teeth approximating in character to those of the black bear. Kidder's bear (*U. a. kidderi*), of the Alaskan peninsula, is another race, stated to differ from the Yakutat bear in its smaller teeth. Other names have been applied to Alaskan brown bears.

Writing of these Alaskan brown bears, Mr. W. H. Osgood observes that "they are of immense size, greatly exceeding the Rocky Mountain grislies and all other bears, except the Polar bear and their own relatives of the Siberian coast. Even the extinct cave bear is by no means a giant in comparison with them. They are confined almost exclusively to the coast region, ranging from Bering Sea throughout the Alaska peninsula and some outlying islands, and thence south along the Pacific coast to the Alexander Archipelago. Their colour varies greatly, ranging from dark seal-brown to buffy brown; but although the ends of the hairs are often paler than the bases, the silver-tipped effect of the grislies is wanting. The front claws are thicker, shorter, and more abruptly curved than in grislies."

"Owing to their great size, the brown bears are doubtless more powerful than the grislies, but they have the reputation of being more peaceable. As a rule, like other wild animals, they give man a wide berth; but in close quarters, or in unusual circumstances, they have been known seriously to injure or kill human beings. Like most other bears, these huge beasts avail themselves of everything the country affords in the way of food, including fish, flesh, fruit, roots, and grass—a variety of diet scarcely exceeded by that of the natives when under aboriginal conditions.

"On coming out from hibernation in the spring they eat young grass, herbage, and roots, and, if near the coast, a little kelp. Later they capture mice and ground squirrels, and when midsummer and the salmon come they make fishing their chief business. In the fall they fatten on berries. The brown bears of Alaska will doubtless become very rare or extinct at no very distant date. Already they have become scarce on Kadiak Island, where they were formerly very abundant, and on the Alaska peninsula, though still fairly numerous, they are being killed at a rate probably greatly in excess of their increase."

It may be added that in summer the Alaskan rivers are almost choked with millions of hump-backed Pacific salmon, which die soon after spawning, and upon which the brown bears almost entirely subsist for several weeks.

THE GRISLY BEAR

By naturalists and popular writers this bear is generally called the grizzly. The fact, however, that the Latin names of this bear are *Ursus horribilis*, *U. horriæus*, and *U. ferox* suggests that the proper English title of the animal is "grisly" (meaning "terrible" or "fierce"), instead of "grizzly" (meaning, in the usual acceptation, "grizzled" or "greyish"); and on turning to Lewis and Clarke's "Travels in Missouri," published in 1814, it will be found that the name used is "grisly," which was no doubt the current spelling at that date. As "grisly" is a somewhat unfamiliar word, while *Ursus horribilis* has a more or less grey coat, there seems to be little doubt that the

original term became corrupted into "grizzly," more especially as "grizzly" is also an alternative spelling for "grisly" in its proper sense. When this change took place I have been unable to ascertain; but the fact that the name *Ursus griseus* is one of the later synonyms of the species may be taken as a proof that the ordinary rendering of the English name is intended to refer to the hoary colour of the animal's coat, and not to its ferocious disposition. The species is here referred to as the grisly bear.

In regard to its right to represent a species by itself, it may be observed that the American grisly bear differs from all the races of the brown bear to a greater degree than do any of the latter from one another.

The grisly bear is specially characterised by the great length of the front claws, which are much longer than the hind ones, and are straighter than those of the brown bear, and whitish in colour. The ears are relatively small, the fur is shaggy and much elongated on the shoulders and flanks, and the hind feet are relatively long.

The general colour of the fur is brownish yellow with a blackish dorsal stripe, the long hair on the shoulders being frequently reddish brown, darkest



GRISLY BEAR AND DEER

THE GRISLY BEAR



A GRISLY BEAR IN ITS NATIVE WOODS

From a photograph by Mr. Turner-Turner

near the tips, which are brownish yellow or brown; the legs are generally black or blackish brown. At the present day, at any rate, the grisly is inferior in size to the great brown bears of Alaska, its length being $6\frac{1}{2}$ feet.

The range of the typical race extends from the Rocky Mountains of Utah to the interior of British Columbia. In Alaska the species is represented by the race known as *U. h. alascensis*, in which the size is larger, while the skull and teeth show distinctive features. In the Sonoran grisly (*U. h. horriæus*) the skull differs from that of the typical race by being concave instead of elevated between the eye sockets; the habitat of this race is the southern Rocky Mountains, from Colorado to Arizona. In the extreme south the species is represented by *U. h. californicus*, of Southern California, which is rather larger than the last, with longer ears.

There is also the small Barren Ground bear of the Hudson Bay district, which, although closely allied to the grisly, American naturalists regard as a distinct species, under the name of *Ursus richardsoni*.

In Alaska, where he recognises two races, Mr. Osgood states that the habits of these bears "are similar to those of the well-known grislies formerly so common in the western United States. In summer they are frequently found above and near the timber line, but they roam widely. At present they are perhaps most numerous in the Endicott Mountains and the Nutzotin and Alaskan Mountains, including the region of Mount McKinley." Of the two Alaskan races recognised by this naturalist, one, called *U. h. phæonyx*, inhabits the interior; while the other (*U. a. kenaiensis*) is found in the Kenai peninsula and adjacent coast region.

A bear from the Tien Shan range of Central Asia, described as *Ursus leuconyx*, agrees with the grisly in its long, white fore claws, and may be the Asiatic

representative of that species, in which case it should be known as *U. horribilis leuconyx*. The instance of the wapiti deer renders it quite likely that grislies occur in both hemispheres.

Accounts of the size and weight attained by grislies have probably been much exaggerated, most of the measurements having been taken from stretched skins; while the weights are generally estimates. Although the biggest grislies are now found in Alaska, it is suggested that those formerly inhabiting the high peaks of the Sierra Nevada were really the largest. These, however, have been nearly or completely exterminated by shepherds, who poisoned them on account of the ravages on their flocks. These Sierra grislies are reported to have been of the enormous weight of 1,800 lb., and there seems little doubt but that instances of 1,400 and 1,200 lb. have been reached.

Dr. Rainsford, however, states that he estimates the weight of the largest grisly with which he was acquainted at 1,000 lb., and gives 900 lb. as that of an unusually large male. The skin of this animal measured 9 feet 3 inches from the nose to the hind foot, when pegged out without undue stretching; and another skin, measured in the same manner, reached 10 feet; while a third was still larger. Such measurements, however, are certainly excessive.

That the grislies will eat flesh whenever they get the chance is admitted by all, but there is some discrepancy of opinion as to whether they ever kill large mammals for the sake of their flesh. Thus, while Sir Samuel Baker denies that they ever do so, Dr. Rainsford relates a case where his hunter saw a grisly attack one of three bisons. Wherever wapiti are abundant there will grisly bears be found. Failing meat, they thrive on nuts, acorns, and so forth; and Dr. Rainsford states that the fattest grislies he ever killed were

those that had been feeding for weeks on the pine-nuts that the mountain squirrels stow away in such great plenty in the little colonies on the upper hillsides. Where the nut-pine is plentiful, one may also expect to find bears. The grisly is a bad climber, and seldom resorts to trees at all. Its strength, however, is prodigious; and one has been seen to break the neck of a bull bison with a single blow of its paw, while another bodily carried off, over very rough ground, a male wapiti weighing nearly 1,000 lb.

In the northern part of its range the grisly bear hibernates, but it is probable that in the south it remains active throughout the winter. When it first comes out in the spring, it has a habit of standing upright against a pine or other tree, and scoring the bark with its claws. Very incorrect conclusions have been drawn from these marks as to the size of the bears, it having been forgotten that the animals were generally standing on from three to five feet of snow when they scored the trees.

The grisly has been accredited with extreme ferocity towards man, but, granting that its great strength and extreme tenacity of life make it a most formidable foe when brought to close quarters, in all likelihood there has been considerable exaggeration on this point, and many of the stories of these animals charging is due to their rolling down-hill upon the hunter who has incautiously fired at them from below instead of from above. Moreover, at the present day firearms have established in the grisly a wholesome dread of man, so that it is now altogether a more cautious and more timid animal than formerly.

THE TIBETAN BLUE BEAR

This small species (*Ursus pruinosus*) is characterised by the generally whitish colour of its coat, upon which are dark markings recalling those of the great panda, in the raccoon family. In this varied type of colouring the blue bear is quite exceptional in its family.

AMERICAN BLACK BEAR

The American black bear (*Ursus americanus*) is a well-marked species, differing from the brown bear, especially in the characters of its skull and teeth, much more decidedly than does the grisly. It is a smaller animal than the brown bear, from which it differs by the proportionately smaller head, sharper muzzle, and more regularly convex profile of the face, as well as by the much shorter hind foot. In length this bear seldom exceeds 5 feet. The fur is less shaggy, and altogether smoother and more glossy than that of either the brown or grisly bear, being typically of a uniform black, except on the muzzle, where it becomes tawny yellow. Occasionally, however, specimens are found with white margins to the lips and white streaks on the chest. The smaller size of the hind feet of this species renders its trail distinguishable at a glance

from that of the grisly bear. The so-called cinnamon bear is merely a pale-coloured phase of the black bear.

The typical race of the species inhabits all the forest regions of North America, except the Gulf States and Labrador, where it is represented by allied races, mainly distinguished by skull characters, such as the Florida *U. a. floridanus*, the Louisiana *U. a. luteolus*, and the Labrador *U. a. sornbergeri*.

Considerable interest attaches to the rare so-called glacier bear described as *Ursus emmonsii*, inhabiting the southern slopes of the St. Elias range and neighbouring mountains, at least from Cross Sound to the vicinity of Cape St. Elias. This bear is believed to live near the numerous glaciers of this region, but its habits are practically unknown, and scarcely a dozen specimens are contained in museums. The glacier bear is similar in size and general characters to the black bear, differing mainly in colour, which is silvery grey slightly mixed with black, the nose being brown and the feet blackish. In certain conditions of coat the colour has a somewhat slaty or bluish grey tinge, from which the animal has been called the "blue bear," although that name properly belongs to the Tibetan species already described.

Certain skins, together with portions of a skull, from Gribble Island, British Columbia, indicate a bear related to the black bear, but creamy white in colour. As this small white bear seems to be fairly common in this part of British Columbia, Mr. Hornaday (who could not believe that it was a mere family of albinos) regarded it as a new species, with the name of *Ursus kermodei*. Two other specimens of this bear, in full winter coat, were obtained in October, 1908, and differ considerably in colour from the type specimen, which, like others mounted in the Provincial Museum at Victoria, were taken in May. In place of being clear,

creamy white, with no trace of brown or black, the new skins had the whole of the top of the head yellowish rufous, while in one the back was conspicuously variegated with bands of bright golden rufous.

Ursus kermodei was at first described as clear, creamy white to the roots of the hairs; but the later specimens differ not only in having the colour of the head distinct from that of the body, but in the basal portion of the hairs of the body being strongly tinged with buff, ranging in tint from pale to orange buff, and in some places to orange rufous. "It is, perhaps, reasonable to suppose," observes Dr. J. A. Allen, "that the buffy suffusion so conspicuous in October specimens may become somewhat faded later in the season, but the rich rufous tint of the

head could hardly thus disappear. So far as the coat is concerned, these skins might readily be looked upon as albinistic examples of a normally dark-coloured black bear."

From the foregoing, it seems practically certain that both the glacier bear and the Gribble Island bear are



THE AMERICAN BLACK BEAR

Photograph by the H. C. White Co.

THE HIMALAYAN BLACK BEAR

pale coloured races of *Ursus americanus*, in which case they should be respectively known as *U. a. emmonsi* and *U. a. kermodei*.

Black bears, according to Mr. W. H. Osgood, are fairly common throughout all Alaska south and east of the treeless tundra. They are among the shyest of animals, and many doubtless slip away without allowing themselves to be seen. Thus, in many districts where fairly common they are supposed to be scarce. The cinnamon phase is common in the interior, but rare or almost unknown on the coast.

As already mentioned, the black bear formerly had a wider distribution than the grisly, extending from Alaska, Labrador, and Canada to the Gulf of Mexico, and from the east to the west coasts of the continent. Colonel D. G. Alexander states that it frequented all the mountains, the thickets of the vast plains, and every creek, river, and bay or bottom.

At the present day, however, its habitat is confined to portions of the various mountain ranges south of the St. Lawrence, the Great Lakes, and, east of the Mississippi, to parts of those districts of the Mississippi and its tributaries which are still unsettled, and where it has been able to escape destruction. Some few are yet found in the dense thickets of the Colorado, Trinity, and Brazos rivers. As with other bears, the male of this species is much larger than the female; when full grown, the former, according to Colonel Alexander, stands about 3 feet in height, and often turns the scale at from 600 to 700 lb.

According to Dr. C. H. Merriam, the food of the American black bear "consists not only of mice and other small mammals, tortoises, frogs, and fish, but also, and largely, of ants and their eggs, bees and their honey, cherries, blackberries, raspberries, blueberries, and various other fruits, vegetables, and roots. It sometimes makes devastating raids upon the barn-yard, slaying and devouring sheep, calves, pigs, and poultry." Mr. C. C. Ward states, as the result of his own experience, that the black bear is growing more carnivorous and more discontented with a diet of herbs.

"It is fortunate that an animal of the ferocity he displays when aroused seldom attacks man. His powerful jaws and terrible canine teeth are well adapted to seize and hold his prey, and his molars are strong enough to crush the bones of an ox. His great strength, however, lies in his forearms and paws. His mode of attacking his prey is not to seize it with his teeth, but to strike terrific blows with his fore paws. His weakness is for pork, and to obtain it he will run any risk. He is a good climber, but owing to his weight is unable to ascend to the tree-tops or climb far out on the branches, although he will go up straight stems to a considerable height after honey. He is an excellent swimmer, and many are killed while swimming in the lakes.

"As a rule, the black bear hibernates, although its torpor is not deep, and the time of entering upon the winter repose depends upon the severity of the

season, and the amount of food supply. Although the males will remain active in any weather, so long as they can find abundance of food, the female is compelled to seek shelter sooner on account of her prospective family. The winter den of a black bear is generally a partial excavation under the upturned roots of a fallen tree, or beneath a pile of logs, with, perhaps, a few bushes and leaves scraped together by way of a

bed, while to the first snowstorm is left the task of completing the roof and filling the remaining chinks."

The cubs are born about January or February, and are two or three in number, although four have been found in a litter. It is believed that the female does not give birth to cubs oftener than every alternate year.



THE AMERICAN BLACK BEAR

THE HIMALAYAN BLACK BEAR

The black bear of the Himalaya (*Ursus torquatus*) is a very different animal from the American, and is readily recognised by the white chevron or inverted cres-

cent on the chest, from which it takes its scientific title, and which stands out in marked contrast to the jetty black of the remainder of the fur. This species does not usually attain such large dimensions as the brown or grisly bear, the length from the tip of the snout to the root of the tail usually averaging in Nepalese examples from about 4½ to 5½ feet, although one specimen has been recorded measuring 6 feet 5 inches. Bears of this species from Kashmir, however, might average somewhat larger.

The fur is very different from that of any of the three preceding species, being short and smooth, without any under fur, and growing very thin in summer. In winter the hair on the shoulders becomes considerably elongated, so as to produce the appearance of a kind of hump. The ears are relatively large and covered with rather long hair. In addition to the white mark on the chest, the chin is also white, while the upper lip may be whitish, and the nose reddish brown. The claws are comparatively short, and black in colour.

Dr. W. T. Blanford gives the weight of full-grown males as varying from 200 to 250 lb.; but these weights are probably exceeded in autumn, when the Himalayan black bear becomes enormously fat, the thickness of the fat on the haunches reaching several inches. At such seasons the skin—never very valuable—becomes utterly useless, being saturated with oil. The skull of this bear has a relatively shorter muzzle and a longer portion behind the eye than that of the brown bear, from which it may also be distinguished by the slight development of the bony ridge along the middle of the brain case, and the generally more slender make and arched profile; the cheek teeth are also relatively weaker and of somewhat different form.

The Himalayan black bear is an exclusively forest-dwelling animal, except in Baluchistan, where it inhabits open country. Its range extends from about the eastern portion of Persia through Baluchistan into Afghanistan and Sind; and thence through the forest-clad portions of the Himalaya to Assam, and so on into

Burma. The species is also found in the south of China, the islands of Hainan and Formosa, and Tibet. The Tibetan race (*U. t. macneilli*) is distinguished by its small cheek teeth and narrow palate, while the Formosan *U. t. formosanus* is characterised by the width and shortness of the skull.

The black bear is found in the Himalaya from near the foot to elevations of some ten thousand to twelve thousand feet in summer. It is, perhaps, most abundant in the dense chestnut and oak woods surrounding the valley of Kashmir, whence it issues forth at night to make extensive depredations on the crops and orchards of the natives. Although it will at times take to killing sheep, cattle, and ponies, it is, as a rule, a vegetable feeder. In the forest the chief food of these bears consists of chestnuts, acorns, roots, berries, ants, and honey. Whenever they raid the cultivated grounds, they consume maize, rice, buckwheat, and a number of fruits, such as mulberries, apples, pears, apricots, and walnuts—the last being especial favourites. The gourds and melons which are cultivated in many of the gardens in Kashmir are also sometimes eaten by these bears, which are so numerous that it is by no means infrequent to see two, three, or even more, up a single fruit-tree in some of the less frequented districts of Kashmir. They are, indeed, excellent climbers, and their short claws are much better adapted for this purpose than for digging.

The black bear, which is known in Kashmir as the siyah hapat (in contradistinction to the kunea hapat, or brown bear), does not thoroughly hibernate, but appears to pass a great deal of its time during the cold months in a state of semi-torpor, occasionally wandering out in search of food when an unusually mild day warms its blood and awakens the sense of hunger.

Like its similarly coloured relative in North America, the black Himalayan bear is sharper in hearing than the brown bear, and it may be that the black colour has some connection with the greater development of this sense. In disposition black bears are decidedly more savage and prone to attack man than are brown bears, and in the fruit season a large number of natives are annually badly mauled in Kashmir by their talons. These wounds, however, are largely due to the foolhardiness of the natives themselves, who will not hesitate to drive off the bears from their crops and orchards when armed solely with sticks. In addition to its skill as a climber, this bear is a good swimmer. The cubs, which are nearly always two in number, are born in the spring.

The Japanese black bear (*U. japonicus*) is so nearly allied to the Himalayan species that it is probably nothing more than a local race, mainly characterised by the white mark on the throat being less distinct. It appears to be very common in Northern Japan, where it is of great importance to the Ainus, who use its skin for clothing, its flesh for food, and the stones in its gall-bladder for medicine. Ainu houses are commonly decorated with the skulls of these bears, and, according to Mrs. Bishop, "the Ainus may be

distinguished as bear-worshippers, and their great religious festival, or saturnalia, as the festival of the bear. In all Ainu houses, and specially the chief's house, there are several tall poles with the fleshless skull of a bear on the top of each; and in most there is also a large cage, made gridiron fashion of stout timbers, and raised two or three feet from the ground. After the capture the bear cub is introduced into a dwelling-house, generally that of the chief or sub-chief, when it is suckled by a woman, and played with by the children, till it grows too big and rough for domestic life, and is placed in a strong cage, in which it is fed and cared for, as I understand, till the autumn of the following year, when, being strong and well grown, the festival of the bear is celebrated.

"The customs of this festival vary considerably, and the manner of the bear's death differs among the mountain and coast Ainus; but everywhere there is a general gathering of the people, and it is the occasion of a great feast, accompanied by much *saké*, and a curious dance, in which men alone take part. Yells and shouts are used to excite the bear, and when he becomes much agitated a chief shoots him with an arrow, inflicting a slight wound, which maddens him, on which the bars of the cage are raised, and he springs forth, very furious. At this stage the Ainus run upon it with various weapons, each one striving to inflict a wound, as it brings good luck to draw his blood. As soon as he falls down exhausted, his head is cut off, and the weapons with which he has been wounded are offered to him, and he is asked to avenge himself upon them. Afterwards the carcass, amidst a frenzied uproar, is distributed among the people, and amidst feasting and riot the head, placed upon a pole, is worshipped—i.e., it receives libations of *saké*, and the festival closes with general intoxication."

THE SPECTACLED BEAR

The spectacled bear (*Ursus ornatus*) of the Andes, the sole representative of the family inhabiting South America, is a small-sized black species, which derives its name from the tawny rings or semicircles round the eyes, whereby a grotesque appearance is communicated to the whole physiognomy. The jaws, cheeks, throat, and chest are white; and the whole length of the animal is only about 3½ feet.

The species is characterised by the great width and shortness of the skull, and the presence of a perforation in the inner side of the lower end of the humerus, or upper arm-bone. It represents a distinct subgenus, *Tremarctus*. The typical race inhabits Chile and Bolivia, but the representative of the species inhabiting Ecuador forms a distinct race (*U. o. majori*), while the name *U. o. frugilegus* appears to

be available for the spectacled bear of the Peruvian Andes, which apparently forms a third local race of the species.

THE MALAY BEAR, OR BRUANG

The small black Malay bear (*Ursus malayanus*) is a very well-marked species, distinguished by its small and rounded ears, covered with short hair, much



THE HIMALAYAN BLACK BEAR

STORIES OF BEARS

elongated and almost prehensile tongue, the very short and wide molar teeth, and the extreme shortness and breadth of the skull, in which the nose is only slightly produced. The claws are considerably curved, and pale in colour. The fur of the typical race of this species is very short and coarse, and mostly black, although tending to brown in some parts; the whole of the muzzle is paler, or whitish, and the light band on the chest varies from white to orange, and is subject to considerable diversity of form, sometimes extending as a streak on to the under part of the body. The average length of the head and body is only about 4 feet, and apparently never exceeds 4½ feet. A fully adult female had a length of only 3½ feet, and did not weigh more than 60 pounds.

This species is found in the Malay Peninsula, and the islands of Sumatra, Java, and Borneo, and extends through Burma into the Garo Hills in North-Eastern India, while it reappears in Tibet, where it forms a local race (*U. m. wardi*), characterised, among other features, by the length of the coat. The bruang has been made the type of the subgenus *Helarctus*, but there may be a question whether it is not a near relative of the spectacled species.

Of its habits Dr. Blanford states that little is known except in captivity. It is a purely forest animal, and an admirable climber. It is essentially frugivorous, but, like other bears, occasionally kills and eats mammals and birds. It is said to be very fond of honey, and probably devours insects and larvæ. When caught young, it is easily tamed, and is usually gentle and amusing in captivity.

The general pace of the Malay bear is much quicker than that of other bears, and a specimen kept some years ago in the Zoological Gardens at Calcutta used to pace up and down its cage with great rapidity, turning suddenly every time it came to the end of its track.

A fragment of the jaw of an extinct bear, obtained from the gravels of the Narbada Valley, in India, appears to indicate a more or less closely allied species; and a fossil bear (*U. etruscus*), from the Pliocene of France, is believed to be nearly allied.

R. LYDEKKER

STORIES OF BEARS

Striking affection for their young is not confined to Polar bears. Lady Bloomfield brought back from the Court of St. Petersburg a story of a Russian bear which deserves a place in any collection of zoological anecdotes.

Count Panin possessed a great property some fifty miles from his château, and went there during Lady Bloomfield's time to hunt bears. After a fruitless chase after two bears and their cubs, he came at night upon a thicket in which he fancied he heard a bear. He fired, but, as it was now dark, he did not care to follow up his shot, but waited till morning. Then he

found that overnight he had shot one of the cubs, which, though mortally wounded, had managed to drag itself into a hollow tree, where it had expired some little time before his return. Count Panin had the body put into an open cart, and returned home with it at full speed to keep an appointment with a friend.

He had barely reached the house when a game-keeper followed him in to say that a large bear had just entered the park. The count and his friends sallied forth, and found the bear in the spot indicated by the keeper. It was the mother of the cub whose body had been brought home. The poor creature had followed the cart which bore her young one through seventy versts (about 52 miles) of open country at the same speed as the post-horses. Such a striking instance of maternal love was deemed by the Count worthy of commemoration, and he erected a monument to record the facts on the spot where the bear was killed.

The same passion for its young marks the famous

grisly. Mr. Roosevelt cites an instance in one of his books, in which Dr. Merrill of the United States Army is the deponent. The doctor was out with an old hunter on the trail of an elk, which they followed into a narrow, deep cañon. Turning a sharp corner, they unexpectedly came upon an old she grisly. She charged immediately, and got so close that it was only by sheer good luck that they managed to disable her with a hurried shot. When the bear had been despatched, the men found that she had been lying across the game trail on a smooth, well-beaten patch of bare earth, which looked as if it had been newly dug up, refilled, and trampled down. Careful examination revealed a glimpse of hide only partially covered at one end. On digging down the hunters discovered the body of a well-grown cub.

The curious thing was that its skull had been crushed and its brain abstracted. The body showed other injuries, too. This was puzzling in the extreme, and the hunters pondered it long. At last they concluded that the cub, in the absence of its dam, had been killed and its brain eaten, either by some old grisly or by a puma. The mother, returning too late to



THE BRUANG, OR MALAY BEAR

save her offspring, had driven off the murderer, buried the body, and lain down above it, waiting to wreak vengeance upon the first passer-by.

Resentment of injury is often singularly displayed. An injured bear will sometimes attack its kind. One adult bear which received, but was not stopped by, a bullet, fell savagely upon its adult companion, and bit and rolled her over, and both fighting, they disappeared into the woods. Another bear, in like circumstances, flew at her cub, and administered a severe bite. A corresponding instinct, however, appears in other animals. A blow from the driver is avenged by an Eskimo dog upon his neighbour, and, by pass-it-on methods, punishment may thus be distributed round the whole team.

Respect for the survival of the fittest would seem to regulate the rearing of the ursine family. An American black bear gave birth at the Zoological Gardens to three blind, naked cubs. All went well for the first day or two. Then the mother was seen to carry one of the cubs in her mouth. It was not afterwards seen; she had eaten it. The supposition is that the cub was weakly, and deemed by its dam unworthy to live.

It is always astonishing that humane people encourage leaders of "dancing" bears. Even a casual observer cannot fail to notice that the animals are subjected to abominable cruelty. They are made to do their tricks by their teacher savagely snatching at a ring fastened through their snouts. Yet the men who lead them flourish. If they ever appear in police-courts, it is not to answer for their cruelty, but for causing an obstruction in the streets. The singular thing is that these maltreated animals seem to entertain an affection for their masters.

A couple of Frenchmen were once locked up for causing an obstruction at Brentford with their bear. The men violently resisted arrest, and were sentenced to a month's imprisonment. But the Bench had reckoned without the bear. The latter absolutely declined to be parted from its masters, and with claws and teeth opposed all attempts at removal. Eventually it was decided to cart him to the "Zoo," and he was inveigled into a 'bus. This did not suit him, so he climbed through one of the windows and stopped the vehicle by simply hanging on to a back wheel. Actually, the two Frenchmen had to be brought out of gaol to lead their animal to the "Zoo." Then they returned to durance vile.

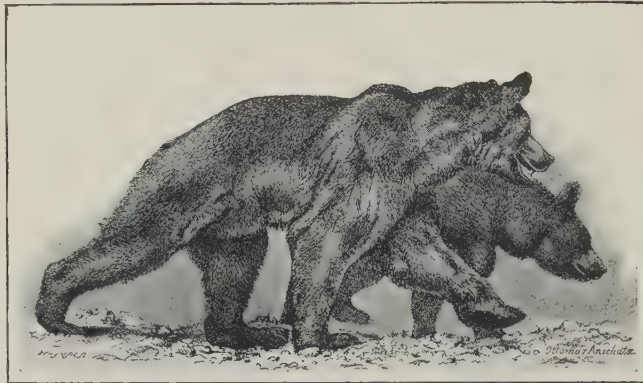
The present writer witnessed a very diverting trick played by a led bear on the ferry between Tilbury and Gravesend. The bear, loosely held on a leash by its master, stood swaying in readiness to leap off, the moment the vessel touched the quay. A semi-intoxicated man, while keeping at what he thought a safe distance from the bear, gratified his own taste and that of a bibulous companion by gibing at the bear leader. The bear showed by its disquiet that it realised that its master was the object of the drunkard's unwelcome attentions. Though its head was fast held, it fidgeted with its hind legs, describing a semicircle. Unable to gain satisfaction in this way, it lay down as

if to rest. It stretched itself at full length, then, with one of its hind legs fully extended, it deliberately swung out at the man, caught him at the back of the heels, and whipped his legs from under him as neatly as a professional wrestler. If ever an animal laughed, a smile adorned the muzzle of that bear as its master's tormentor sprawled upon the deck, then scrambled with cries of alarm into a place of safety. Somehow, one could not but feel that, in spite of its ringed nose, that bear had rather a kind master. E. A. B.

THE EXTINCT CAVE BEAR

No account of the typical bears would be complete without some reference to the great extinct cave bear (*Ursus spelæus*), of which the remains are found in such profusion in the caverns of Europe, and less commonly in the brick-earths and other superficial deposits. This gigantic species was a contemporary of the mammoth and early human inhabitants of Europe. The skull is distinguished by the great

prominence immediately above the eyes; while the molar teeth are characterised by the extremely fine tuberculation of their crowns, in which, when unworn, the enamel has a kind of wavy pattern. Formerly, this bear was supposed to be the largest of the whole group, but it is now known to be rivalled, if not equalled, by the big brown bears of Alaska and Kamchatka. This bear is evidently a near ally of the brown species, but as it occurs in the same districts



BROWN BEARS ON THE MARCH

where remains of the latter are found, it seems entitled to rank as a species by itself.

The cave bear, although it had a wide range in Europe, is unknown both in the extreme north and the extreme south of that continent; it is found in the British Isles as far north as Yorkshire, and also occurs in Ireland. The number inhabiting Brixham Cave near Torquay, and the celebrated cavern of Gailenreuth in Bavaria, must have been very great, although, of course, they did not all occupy these places at the same time. From its size and its numbers, it must have been a formidable foe to the early hunters of Europe, armed only with flint hatchets and spears.

THE SLOTH-BEAR

The Indian sloth-bear (*Melursus ursinus*), commonly known in its native country by the name of bhalu, but by the Mahrattas termed the aswal, differs so remarkably from all the other members of the family that it is regarded as forming a genus by itself. It differs from the more typical bears in having only two pairs of incisor or front teeth in the upper jaw, so that the total number of teeth is forty, instead of forty-two. Moreover, all the cheek teeth are much smaller in proportion to the size of the skull than in other bears, while the palate of the skull is deeply concave, instead of being nearly flat. The claws are also unusually large and powerful, and the snout and lower lip much elongated and very mobile.

The sloth-bear is, at best, an ugly-looking animal, and generally of smaller size and less bulk than the Himalayan black bear. It is covered with very long and coarse fur, which attains its greatest length on

THE SLOTH-BEAR

the shoulders. With the exception of the end of the muzzle being dirty grey, and of the white chevron on the chest, the colour of the fur is black, but the long claws are white. As regards size, this species measures from about 4½ feet to 5 feet 8 inches in the length of the head and body, the tail measuring from 4 to 5 inches, exclusive of the hair; the height at the shoulder varies from 2 feet 2 inches to about 2 feet 9 inches. Large males may weigh as much as 280 lb., and one specimen is recorded as weighing as much as 320 lb.

One of the commonest and most characteristic of the mammals of India, the sloth-bear is found in Ceylon, and in the peninsula of India from Cape Comorin nearly to the foot of the Himalaya, ranging as far west as the province of Kathiawar, and also occasionally occurring in Cutch, while to the northwards its range is probably limited by the great Indian desert. It occurs in North-Eastern Bengal, but how far its range extends in this direction is not ascertained, there being some doubt whether the large black bear found in the plains of Assam is this species or the Himalayan black bear. Within the latter half of the nineteenth century it was completely exterminated in some parts of Bengal and the Deccan.

Dr. W. T. Blanford states that these bears are generally found solitary, or in pairs, or three together; in the last case a female with two cubs, often nearly or quite full-grown. Occasionally, four or five are met with in company. They inhabit bush and forest, jungle and hills, and are particularly fond of caves in the hot season and monsoon, and also when they have young. It roams in search of food at night, and near human habitations is hardly seen in the daytime; but in wild tracts uninhabited by man it may be found wandering about so late as eight or nine o'clock in the morning, and again an hour or even more before sunset. In wet or cloudy weather, as in the monsoon, it will sometimes keep on the move all day.

This bear does not hibernate. "Owing to its long, shaggy, coarse fur, its peculiarly shaped head, its long mobile snout, and its short hind legs, this is probably the most uncouth in appearance of all the bears, and its antics are as comical as its appearance. Its usual pace is a quick walk, but if alarmed or hurried, it breaks into a clumsy gallop, so rough that when the animal is going away it looks almost as if propelled from behind and rolled over and over. It climbs over rocks well, and, like other bears, if alarmed or fired at on a steep hillside, not infrequently rolls head over heels downhill. It climbs trees, but slowly and heavily, the unmistakable scratches left on the bark showing how often its feet have slipped back some inches before a firm hold was obtained."

As might be inferred from the small size and half-rudimentary condition of its molar teeth, the food of the sloth-bear consists almost exclusively of fruits, flowers, and insects, together with honey. Its favourite fruits are those of the ebony tree, the jujube plum, several kinds of figs, and the long pods of the cassia. During the months of February and March, in many parts of India, the beautiful fleshy, white flowers of the mowha tree are nightly shed in great profusion, and form a rich feast for many denizens of the jungle, prominent among them being the sloth-bear, by which these flowers are greatly relished. In addition to beetles and their larvæ, as well as young bees and honey, the sloth-bear is also passionately fond of white ants, or termites.

On this point Colonel Tickell observed that "the power of suction in this bear, as well as of propelling wind from its mouth, is very great. It is by this means it is enabled to procure its common food of white ants and larvæ with ease. On arriving at an ant-hill, the bear scrapes away with the fore feet until he reaches the large combs at the bottom of the galleries. He then, with violent puffs, dissipates the dust and crumbled particles of the nest, and sucks out the inhabitants of the comb by such forcible inhalations as to be heard at two hundred yards' distance or more. Large larvæ are in this way sucked out from great depths under the soil. Where bears abound, their vicinity may be readily known by numbers of these uprooted ants' nests and excavations, in which the marks of their claws are plainly visible. They occasionally rob birds' nests and devour the eggs. The sucking of the paw, accompanied by a drumming noise when at rest, and especially after meals, is common to all bears, and during the heat of the day they may often be heard humming and puffing far down in caverns and fissures of rocks."

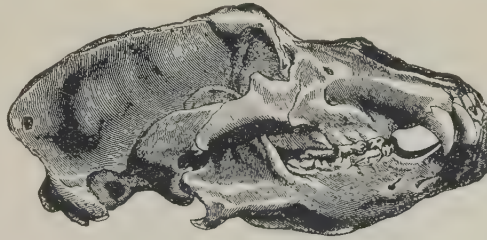
Like flying foxes and palm-civets, the sloth-bear will often visit the vessels hung on the palm trees for the sake of their juice, and is said frequently to become very drunk in consequence. Sugar-cane is likewise a favourite dainty of these bears, which frequently do a large amount of damage to such crops. Although they generally subsist entirely on vegetable substances and insects, it seems that they will occasionally eat flesh; Mr. G. P. Sanderson mentions an instance where one of them devoured the carcase of a recently killed muntjac, the proof that a bear was the devourer being afforded by the imprints of its feet in the wet soil. The same observer also mentions that he has known bears gnaw the bones of cattle that have died in the jungle.

Like most other members of the family, the sloth-bear has

the sense of hearing poorly developed, and its eyesight is also far from good, so that it has a peculiarly comical way of peering about when it suspects intruders, as though it were short-sighted. From these deficiencies of sense it can be approached very closely from the leeward side. Its sense of smell, however, is wonderfully acute, and enables it to detect concealed supplies of honey, and also to scent out ants' nests when situated far below the ground.

The number of cubs produced at a birth is, as with most bears, usually two, but there may sometimes be three. The young cubs are generally carried on the back of the female when the animals are on the move, and it is an amusing sight to watch them dismount at the feeding-grounds, and scramble back to their seat at the first alarm. The cubs are carried about in this manner till they are several months old and have attained the dimensions of a sheep-dog, and when there is room for only one on the maternal back the other has perforce to walk by the side.

Although generally timid in their nature, sloth-bears will on rare occasions attack human beings without provocation, and, when they do so, fight both with teeth and talons and inflict terrible wounds, more especially on the head and face. These attacks commonly occur when a bear is accidentally stumbled upon by a native wandering in the jungle, and are then due more to timidity than to ferocity. Probably, indeed, a bear, being a slow-witted animal, is more likely to attack in such a case than is a tiger or a leopard,



SKULL OF THE CAVE BEAR

which more rapidly collects its senses, and is thus less embarrassed by the unexpected encounter.

When thus surprised, a sloth-bear will sometimes merely knock a man over with its paws, although thereby inflicting severe wounds, but on other occasions it seizes and holds in its paws its victim, who is not released until bitten and clawed to death. Females with young, and occasionally solitary bears, will at times make unprovoked attacks of great ferocity.

Sloth-bears are usually hunted either by driving them from covert with a line of beaters, or by the sportsman going to their caves or lairs among the rocks at daybreak, and shooting them as they return home from their nightly wanderings. Mr. Sanderson, when in the forests of Mysore, was in the habit of shooting bears by following them with trackers; and as they seldom left off feeding before nine in the morning, it was generally possible, by starting at daybreak, to come up with them before they had retired to rest for the day. If, however, the party did not succeed in this, the bears would be found lying asleep under the shade of a clump of bamboos, or a rock, as there were no caves in the district into which they could disappear. Elephants have a great dislike to bears, and on this account, as well as from the rocky nature of the country inhabited by these animals, are rarely employed in bear-shooting.

Formerly, in the extreme south of India, among certain hill-tribes known as Polygars, sloth-bears used to be hunted with large dogs, and when brought to

serves to indicate that the sloth-bear is a specially modified form derived from bears belonging to the typical genus, since the skull of that species presents characters intermediate between those of ordinary bears and that of the sloth-bear.

EXTINCT BEAR-LIKE MAMMALS

At the close of the account of the dog family it was mentioned that, unlike as modern dogs and bears are to each other, yet the two families are merely divergent branches from a common stock (p. 480). In that passage reference was made only to those extinct animals most nearly related to the existing members of the dog tribe, and it was shown that the *Amphicyon* of the Miocene and Oligocene period appears to be a dog with one more pair of upper molar teeth than the true dogs, and approaching the bears in its plantigrade feet.

Mention may now be made of certain extinct genera more nearly allied to the modern bears. The first of these is a bear-like animal from the superficial deposits of South America known as the *Arctotherium*. This animal had the same number of teeth as the true bears. The upper molar teeth, however, are relatively shorter and wider than in the latter, and the second is not greatly larger than the first. Then, again, the upper flesh tooth is much larger than in modern bears, and thus more like the corresponding teeth of other Carnivora. Further, the upper arm bone, or humerus, has a perforation at its lower end, which is not found in any living dog, although occurring in the South

American spectacled bear, and the extinct *amphicyon*. These *arctotheres* were common in Argentina, and entered South America from the north.

Another type is the *Hyænarctus*, of which large species occur in the Siwalik Hills of India and the Pliocene deposits of Europe, while smaller ones are found in the European Miocene strata. In these animals the upper molars were sometimes oblong, with the second not longer than the first; while in other cases they were more or less completely triangular, and thus little different in form from the corresponding teeth of dogs. The most important difference from the bears, however, occurs in the form of the flesh tooth in both jaws, these teeth



THE SLOTH-BEAR

bay were attacked by the hunters with long poles smeared at the end with bird-lime. The bird-lime caused the shaggy coat of the bears to become fixed to the end of the pole, so that the animals were firmly held.

A single fragment of a bone of the fore limb discovered in a cave in Madras proves that the sloth-bear has been an inhabitant of India since a period when several kinds of extinct mammals flourished there. And the extinct Theobald's bear (*Ursus theobaldi*), from the Siwalik Hills of Northern India,

being very similar to those of the dogs, and of a thoroughly carnivorous type. But while the upper flesh tooth of the dogs has only two lobes to its cutting blade, that of the *hyænarctus* had three such lobes.

Another Miocene carnivore, known as *Hemicyon*, has still more dog-like teeth; and the transition from this animal to the plantigrade and dog-like *Amphicyon* is, therefore, scarcely more than a step, so that the passage from the dog-like bears to the bear-like dogs is practically complete.

THE RACCOON TRIBE

THE raccoons and their allies constitute a very small family (*Procyonidæ*) of Carnivora, which, with the exception of two outlying and somewhat aberrant genera, are confined to America, and are very characteristic of the central and southern portions of that continent. Their nearest allies are the bears, with which they are connected by the pandas, and more especially by the short-tailed species, which have the same number of teeth as the raccoons.

With the exception of the great panda, the raccoons agree with the bears in their plantigrade feet, but differ in that they have only two, in place of three, molar teeth in the lower jaw. The upper molar teeth are usually of the same general type as those of the dogs, having squared or triangular crowns, and being generally elongated in the transverse rather than in the antero-posterior direction; while the second of these teeth is smaller, instead of larger, than the first. Moreover, the flesh tooth in each jaw approaches the ordinary carnivorous type, and is thus very different from the corresponding tooth of the modern bears; the upper one, however, has three lobes to the blade, and two cusps on the relatively large inner tubercular portion.

Except the great panda, all the members of the raccoon family are animals of comparatively small size, and differ markedly in appearance from the bears in having well-developed tails, which may be of great length. Very generally the hair of the tail is marked by alternate dark and light rings. The great majority of these animals are good climbers, and of more or less exclusively nocturnal habits. It is noteworthy that, with the exception of some belonging to one of the Old World genera, no remains of this family have ever been discovered beyond the limits of the New World.

THE GREAT, OR SHORT-TAILED, PANDA

A large number of the mammals from the highlands of North-Western China and Tibet belong to types quite unlike those found in any other part of the world; and in no case is this dissimilarity more marked than in the animal known as the great, or short-tailed, panda (*Æluropus melanoleucus*).

This strange creature, first made known to European science in 1869, is of the approximate dimensions of a very small brown bear, and has a general bear-like aspect, although differing from ordinary bears in its parti-coloured coat, of which the fur is long and close, with a thick, woolly under fur. The general colour is white, but the eyes are surrounded with black rings, the small ears are also black, while the shoulders are marked by a transverse stripe of the same colour, gradually increasing in width as it approaches the fore limbs, which are also entirely black, as are likewise the hind limbs. This peculiar type of colouring communicates a most extraordinary appearance to the creature; and without knowing more of its natural surroundings, it is difficult to imagine the object of such a staring contrast. The tail is extremely short, and the soles of the feet are hairy. Although the face

is to a certain degree bear-like, it presents a still greater resemblance to that of the true panda.

In addition to these external characteristics, the great panda presents certain distinctive and peculiar features in regard to the skull and teeth. The skull, for example, is remarkable for its vaulted profile, the great width of the zygomatic arches, and the enormous development of the longitudinal ridge on the upper surface of the brain case, all these features indicating greater power of jaw than in any other member of the carnivorous order. Then, again, the teeth differ both in number and form from those of all the *Ursidæ*.



THE GREAT, OR SHORT-TAILED, PANDA

Instead of the forty-two teeth characteristic of typical bears, the great panda has a total of only forty teeth, the diminution in number being due to the absence of the first pair of premolar teeth in the lower jaw.

As regards form, the molar teeth are distinguished from those of bears by their shorter and wider crowns, this being most marked in the first molar of the upper jaw, which is broader than it is long. The second upper molar tooth, however, agrees with the corresponding tooth of the bears in being longer than the one in front of it. The pattern formed by the tubercles on the crowns of these teeth is exceedingly complex, and approaches to the type obtaining in the true long-tailed panda. Many features of the skull are also panda-like, while as regards the bones of the legs and feet, these come closer to those of the panda than to those of the bears.

From these facts, some naturalists are of opinion that *Æluropus melanoleucus*, which was formerly classed with the bears, under the name of the parti-coloured

bear, is really a member of the raccoon tribe, although serving in some degree to connect this family, by means of the true panda, with the *Ursidae*.

The first specimens of the great panda were obtained by the missionary Abbé David, from Moupin, a district long supposed to be in Tibet, but really in the Sze-chuen province of North-Western China. The species also inhabits the adjacent province of Kansu, and may perhaps extend into the wooded portion of Tibet. Although no European has hitherto succeeded in shooting a specimen, it seems certain that the great panda inhabits the highlands of Sze-chuen, which are clothed with a great jungle of bamboo and rhododendron, and have an extremely wet climate in summer, with heavy falls of snow in winter. According to native report, the great panda is entirely herbivorous, feeding chiefly on roots and the young shoots of bamboos, this statement according well with what we know of the vegetation of its native country.

PANDA

The animal known by its native name of panda (*Elurus fulgens*) is one in regard to whose serial position much diversity of opinion has obtained among naturalists. It was at one time placed in the bear family, next to the great panda; while it has also been regarded as the representative of a family by itself. Some years ago, however, Dr. W. T. Blanford came to the conclusion that its true position is in the raccoon family, and this view has been very generally adopted by naturalists.

The panda, or as it is often called the red cat-bear, is restricted to the South-Eastern Himalaya and North-Western China, and may be compared in size to a large cat. Externally it is characterised by its broad and rounded head, in which the muzzle is extremely short; the small eyes are directed forwards, and the ears are of considerable size. The stout limbs are furnished with large, curved, and sharp claws, which can be partially retracted; and the soles of the large, plantigrade feet are covered with hair. The tail is long and rather thick, its length being nearly equal to that of the body, or rather more than two-thirds of that of the head and body together. The fur is long and thick, with a woolly under fur.

In colour, a large portion of the fur of the panda is bright rusty red, of somewhat variable shade; this tint prevailing on the back, the upper part of the head, and the darker rings on the tail. The forehead is of a lighter shade of red, as are also the paler rings on the tail, of which the tip is black. The under parts and the inner surfaces of the limbs are black, tending to a brownish tint on the abdomen. The face, like the lower lip, is white, except for a vertical stripe of red proceeding from each eye to the angle of the mouth. Occasionally, however, there is also a red stripe running down the middle of the nose. The inner surfaces of the ears are also white, as are also the claws. A large male panda measured 24 inches from the tip of the snout to the root of the tail, while the length of the tail was 17 inches without the hair at the end, and 19½ inches inclusive of the hair. Other specimens measured respectively 20 and 22 inches to the root of the tail.

It is, however, not only externally that the panda is a remarkable creature, as in its skull and teeth it is very unlike all other Carnivora except its larger relative. The skull, for instance, is remarkably short, with the profile from the front teeth to the occiput forming a regular curve, which approximates to a semicircle. The lower jaw is also remarkable for its extremely convex and regularly curved inferior border, and also for the great length of the portion which ascends on the side of the skull. The total number of teeth in the panda is thirty-eight, of which on each side of the jaws $\frac{2}{3}$ are incisors, $\frac{1}{4}$ canines, $\frac{3}{4}$ premolars, and $\frac{2}{4}$ molars.

The canines, or tusks, are of no great size, but remarkably flattened from side to side. The upper molars have very wide crowns, which are nearly square in outline, and carry four main tubercles and an inner ridge; while the flesh tooth in each jaw differs from the corresponding tooth of the more typical members of the family in presenting little approximation to the ordinary carnivorous type, although the upper one has the characteristic two inner cusps. In all these respects the species approximates to the great panda, from which it differs in having one pair of lower molars less. In its ringed tail, as well as its habits, the panda resembles the typical raccoons.

There is some doubt as to the origin of the name panda, by which the animal is generally known in Europe, unless, indeed, it be a corruption of the Nepalese *niyalya-ponga*; the latter name, apparently, meaning "bamboo-eater." The animal is also known in Nepal as the wah. The panda is unknown in the Himalaya to the west of Nepal, where it lives at elevations of from seven thousand to twelve thousand feet. Its eastward range extends through the mountains to the north of Assam into the Chinese provinces of Yunnan and Sze-chuen.

As might be inferred from the structure of its teeth, the panda is mainly herbivorous. Its food is composed of various fruits, acorns, the young shoots of bamboo roots, and so forth, but it will also eat eggs, although it is doubtful whether, as asserted, it will touch insects or their larvæ; all observers are in accord as to its

habitual rejection of any kind of flesh. In Nepal pandas sometimes steal down to the villages to feast on the milk and butter of the natives. These animals feed in the morning and evening, and sleep much during the day, although they are by no means exclusively nocturnal in their habits. On the ground their movements are awkward and ungainly; they are sluggish and stupid in disposition, and



THE PANDA

allow themselves to be captured without much difficulty. They hiss and spit like cats when angered, and occasionally utter a low deep growl, somewhat like that of a young bear.

Pandas have been stated to drink by lapping with the tongue, but from observations made on specimens in the Zoological Society's Gardens in London, it appears that they drink by putting their noses to the water, after the fashion of a bear. They generally sleep curled up sideways, with the head concealed by the

RACCOONS

thick tail, but also frequently repose by sitting down on their haunches with the head tucked in between the fore paws, their habits being thus very similar to those of some of the raccoons.

From the account of an observer who watched a pair of these animals high up in the trees near Darjiling, the panda at certain times—probably the breeding-season—utters loud unearthly cries, which may be heard at a considerable distance. They call one another by a kind of chirp. The panda is a harmless and apparently almost defenceless animal, its sharp and partially retractile claws being adapted to the

been formerly thickly covered with forest and have enjoyed a subtropical climate.

RACCOONS

The well-known raccoons, of which there are two or three species, are the typical representatives of the family, and, like all the remaining forms, exclusively American. These animals have a total of forty teeth, or two more than in the panda, owing to the presence of the whole of the four typical pairs of premolars in the lower jaw. The cheek teeth differ from those of the latter in being more like the ordinary carnivorous type; while the skull has not the short and convex form of that of the panda.

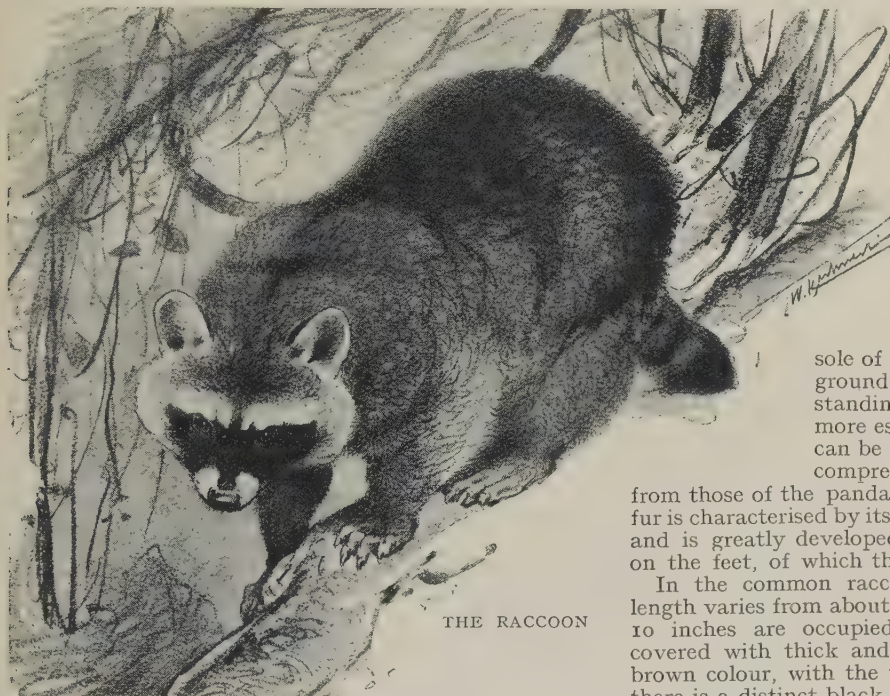
Externally raccoons are characterised by thickly-built and stout bodies, heads broad behind but tapering to a sharp point at the muzzle, and medium-sized and distinctly-ringed tails. The ears are small and rounded.

When walking, the entire sole of the foot is not applied to the ground, as it is when the animal is standing at rest; while the toes, and more especially those of the fore feet, can be spread out very widely. The compressed and curved nails differ

from those of the panda in being non-retractile. The fur is characterised by its length, softness, and thickness, and is greatly developed on the tail, but is very short on the feet, of which the soles are naked.

In the common raccoon (*Procyon lotor*) the total length varies from about 32 to 36 inches, of which some 10 inches are occupied by the tail. The body is covered with thick and rather coarse fur, of a dark brown colour, with the tips of the hairs greyish; but there is a distinct black patch on each side of the face, including the eyes, and the muzzle is naked. The tail has five black rings, separated by others of a whitish colour, and its tip is black. When in its best condition, which is usually in the autumn, a raccoon will weigh from 15 lb. to 25 lb. There is considerable local variation in the colour of this species; the colouring being most brilliant in the southern portion of its range, where the bodily size is also greater than in the north. The raccoon is confined to North and Central America, extending from Alaska to Costa Rica, and occurring over the whole of the United States, where it used to be among the commonest of animals.

Dr. Hart Merriam states that raccoons are exceedingly common about the borders of the Adirondacks, but avoid the dense evergreen forests of the interior. Although, with the exception of bats and flying squirrels, they are the most strictly nocturnal of all North American mammals, yet they may occasionally be seen abroad on cloudy days. In diet they are thoroughly carnivorous—feeding on mice, young birds, birds' eggs, freshwater tortoises and their eggs, frogs, fish, crayfish, freshwater mussels, insects, nuts, fruits, and corn, while they will sometimes kill and eat domesticated poultry. They delight to sport in the shallow water on the margins of pools and streams, where they capture crayfish lurking beneath the stones, and mussels buried in the mud and sand. They also catch such fish as happen to get stranded or detained in the small pools near the shore; and



THE RACCOON

purpose of climbing, rather than as weapons of offence or defence.

The young, usually two in number, are born in a nest formed in some hollow tree or cavity among rocks. They are produced in the spring and are helpless for a long period. It is stated that the cubs of one litter remain with the parent till shortly before the birth of a second family.

In captivity these animals are gentle and easily tamed, even when captured after they have attained maturity. In Europe they require great care and attention, from their extreme susceptibility to cold, but in the more congenial climate of Calcutta they thrive well in cages placed in the open air.

The Sze-chuen race of the panda (*A. fulgens styani*) is characterised by the prevalence of black in the colouring, which renders the skins remarkably handsome. It inhabits much the same districts as the great panda.

It is remarkable that an extinct species of panda, about half as large again as the living form, once flourished in England. This is proved by the occurrence of teeth and fragments of jaws in the so-called Red Crag of the Suffolk coast, which belong to the Pliocene period; while remains of another species have been met with in the Miocene of the Continent. It is, therefore, probable that the group was once widely spread over the Old World, and its occurrence in England indicates that the country must have

although they are unable to dive in pursuit of their prey, they are good swimmers.

Although first-rate climbers, and making their nests in hollows high up in large trees, raccoons cannot be considered thoroughly arboreal animals. Thus, they neither hunt their prey among the tree-tops, nor gather nuts and fruits from the branches, nor do they feed upon the young shoots and twigs. Trees, however, form their resting and their breeding places, and likewise their refuge when pursued by human or other foes. With the falling shades of night they descend to hunt their prey and search for food.

Dr. Merriam states that in the Adirondack region the raccoon hibernates during the severest part of the winter, retiring to its nest rather early, and appearing again in February or March, according to season. Probably in Central America and the more southerly districts of North America it remains active throughout the winter, as the climate does not necessitate hibernation. In the Adirondacks the young are produced in the spring, generally during the month of April; and there are usually from four to six in a litter. They remain with their parents for about a year. The nest, placed high up in a tree, has little care bestowed upon its construction.

It has long been known that the raccoon is in the habit of moistening its food with water before eating it; and it doubtless received its distinctive specific name from this habit, which has been verified by observations on specimens in the London Zoological Society's Gardens. The raccoon is one of the most important of the fur-bearing animals of North America, and consequently much persecuted. Skins were formerly used as a recognised circulating medium in the states of the Mississippi Valley, and were usually valued at 25 cents apiece.

Raccoons may be easily caught in steel traps, but it is essential that these should be set under water near the margins of swamps or streams. The more sporting method is to hunt these animals at night with specially-trained dogs, usually a breed of foxhounds. It has often been stated that the raccoon leaves a very faint foot-scent; but this opinion is controverted by Mr. D. Arrowsmith, who states that he has known a hound hunt a raccoon at midday over snow, on a trail which had been made the previous night. The raccoons, after a short run, invariably take to the trees, where they are shot by the hunter, unless they conceal themselves in a hole.

The crab-eating raccoon (*Procyon cancrivorus*) is a nearly-allied South American species, distinguished by its superior dimensions and much shorter fur, as well as by its proportionately larger teeth. It is found typically from Panama to Colombia and Guiana, but also ranges farther to the south, extending through to Brazil to Paraguay, where its representatives are distinguished by their darker feet. These raccoons are very common in certain districts, and appear to agree closely in habits with their northern cousin.

CACOMISTLES

The cacomistle (*Bassariscus astutus*) is an animal nearly allied to the raccoons, but of more slender build, with a sharper muzzle, longer tail, less perfectly plantigrade feet, and teeth of a more typically carnivorous type. It is an inhabitant of the United States and Mexico, and is covered with long and soft fur, and has large and pointed ears, of which the outer surfaces are nearly naked. The feet have naked pads, but are otherwise hairy, and their short claws are partially retractile.

In size this animal may be compared to a cat, the length of the head and body being about 17½ inches, and that of the tail, including the hair at the end, nearly the same. The general colour is brownish yellow mixed with grey on the upper parts, and whitish

below, but the tips of the ears and two pairs of spots above and below the eyes are yellowish white. The bushy tail, which differs from that of the raccoons in being depressed instead of cylindrical, has a black tip and seven or eight blackish brown rings, separated by white intervals.

Cacomistles dwell among rocks and trees, and although, on account of their purely nocturnal habits, seldom seen, are far from uncommon in certain localities. Like raccoons they are easily tamed, and make pretty pets, being sometimes kept for the purpose of killing rats and mice. They are, however, for their size, bold and ferocious animals, reported to be very destructive to poultry. Cacomistles prefer woods well supplied with water, where they make their nests in holes in trees. The natives are in the habit of finding out whether such a hole is tenanted by noting if the bark surrounding the aperture has been removed; this removal being an invariable custom of the animal. From three to four young are produced at a birth. The tail is carried bent back over the back. A second species, Sumichrast's cacomistle (*B. sumichrasti*), inhabits Central America.

BASSARICYONS

Two allied animals, *Bassaricyon gabbi* from Costa Rica and Panama, and *B. alleni* from Ecuador, form

a genus by themselves. These species, which are rare in collections, have the same number of teeth as raccoons, but approximate so closely in appearance to the kinkajou, that they are probably often mistaken for it by collectors. It has been suggested that the resemblance between the two groups is a case of true mimicry, although it is difficult to imagine what advantage it can be for a bassaricyon to be mistaken for a kinkajou.

COATIS

The coatis, or, as they are often called, coatimundis, are easily recognised by the great length of their snouts, on which account they are called by the Germans *Rüsselbären* ("proboscis-bears"). They have the same number of teeth as raccoons, but the tusks, or canines,



1 AND 2. THE COMMON RACCOON
3. THE RING-TAILED COATI

THE KINKAJOU

are longer and more flattened, while, in conformity with the length of the snout, the skull is relatively longer and narrower.

The snout, which is naked at the tip, is somewhat upturned and projects far beyond the extremity of the lower jaw, so that it is capable of a considerable amount of movement. The body is long and rather flattened, and the tapering tail also elongated and of considerable depth. The toes are more closely connected than in raccoons and provided with longer and stouter claws.

The common, or white-nosed, coati (*Nasua narica*) inhabits Mexico and Central America, and is characterised by the white nose and upper lip, the dark brown face and cheeks, and the length and softness of its fur. The long hairs of the back are tipped with rufous, or fulvous, or whitish colour, and the tail is frequently of the same colour as the back, though it may have dark and light rings on the under side of the basal half, or complete rings.

A second species is the red coati (*N. rufa*), inhabiting South America from Surinam to Paraguay, in which the fur is generally short and harsh, with the longer hairs on the back tipped with black. The ears are relatively larger and more hairy, and the tail is invariably marked with from seven to nine broad tawny or rufous rings alternating with black ones, the tip being black. Both species, however, are subject to local variations of colour, and the distinction between them is sometimes difficult to make out. Other species have been named.

Coatis usually go about in small troops, comprising from about eight to twenty individuals, and are mainly arboreal. Their food includes fruits, young birds, eggs, lizards, and insects. In Costa Rica they are found in the mountains at elevations of from six thousand to seven thousand feet. In Nicaragua Mr. T. Belt observed them hunting the large lizards known as iguanas. When an iguana was surprised by a coati, it immediately fell from the bough on which it was reposing to the ground, and thence escaped to another; but, nothing daunted, the coati would renew the pursuit again and again. Frequently the coatis would divide their troop into two sections, one of which made its way through the branches above, while the other hunted on the ground below, so that any prey that fell from the trees had a poor chance of escape.

In Guatemala coatis are very common mammals, and may be found at all elevations in the mountain forests, from the level of the sea up to nine thousand feet. They are readily tamed, and often kept by the Spaniards in South America chained to one of the pillars of the

corridor surrounding the courtyards of their houses. That coatis are aboriginal inhabitants of South America is proved by the occurrence of their fossilised remains side by side with those of many extinct mammals in the caverns of Lagoa Santa, in Brazil. They are also represented in deposits of still earlier age in Argentina, where the species have been referred to a distinct genus (*Cynonasua*).

KINKAJOU

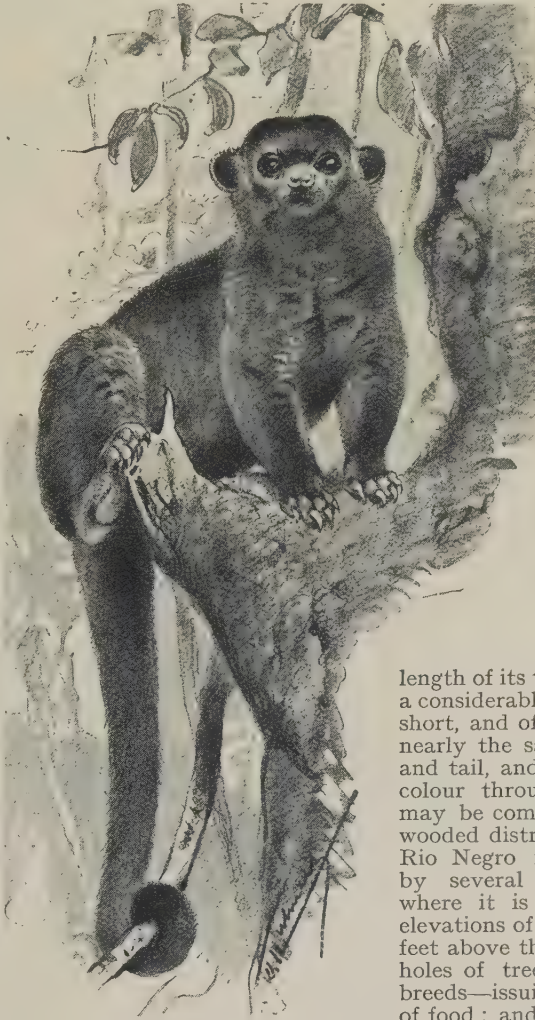
The last representative of the raccoon family is the kinkajou, or jupura (*Cercoleptes caudivolvulus*), now termed by some naturalists *Potos flavus*, which is the most arboreal form of all, and distinguished by its prehensile tail—a character it possesses in common with the Indian binturong. The kinkajou is differentiated from the other American members of the family by having only thirty-six teeth, owing to the disappearance of a pair of premolars in each jaw.

It is a long and rather low-bodied animal, with a rounded and broad head, in which the muzzle is short, and the front of the nose marked by a median vertical groove. The ears are small and rounded; and the limbs short, with naked soles to the feet, and long, powerful, and much curved claws. The prehensile tail is cylindrical, of moderate thickness, and of great relative length, being fully as long as the head and body together.

The kinkajou is further distinguished by the great length of its tongue, which can be protruded a considerable distance. The fur is soft, short, and of an almost woolly nature, with nearly the same length over the whole body and tail, and is of a pale yellowish brown colour throughout. In size the kinkajou may be compared to a cat. It is found in wooded districts from Central Mexico to the Rio Negro in Brazil, and is represented by several local races. In Guatemala, where it is far from rare, it ranges to elevations of between four and five thousand feet above the sea. It conceals itself in the holes of trees—in which it probably also breeds—issuing forth only at night in search of food; and feeds on small mammals, birds and their eggs, honey, and fruits, and is specially partial to oranges and bananas.

A specimen which fell, when wounded, from a tree into a river below swam well.

The expression of the kinkajou reminded Mr. Bates strongly of that of some of the lemurs, and he was also struck with the extreme brightness of its dark eyes. When on an excursion along the low Ygapo shores of the Tefé, about twenty miles above Ega, on the Upper Amazon, this naturalist met with a number of these animals, and kept a young one as a pet for several weeks, feeding it on bananas and mandioca meal mixed with treacle. It became tame in a very short time, allowing itself to be caressed by its master.



THE KINKAJOU

THE WEASEL TRIBE

THE weasel family (*Mustelidae*), in which are included weasels and their immediate allies, badgers, and otters, form the last group of terrestrial Carnivora. The family is very extensive, and one in which many of the various members differ very widely in appearance and in the structure of their teeth. A large number of the species—and among them the typical forms—however, are characterised by their long and slender bodies and short limbs, while the great majority are of medium or small size, and none is very large.

In the general characters of the base of the skull the members of the weasel family agree with the bears and raccoons. They are, however, distinguished from those animals by having only a single pair of molar teeth in the upper jaw, while they agree with the raccoons in possessing two pairs of these teeth in the lower jaw, although the rats have only a single pair of lower molar teeth. The skull may always be distinguished from that of any other carnivore by the inner portion of the upper molar tooth being wider in the longitudinal direction of the jaw than its outer portion. The skull is further characterised by the great development of the curved ridges of bone by which the lower jaw is held in place, and which grip the condyles of the latter so tightly that it is sometimes difficult or impossible to detach it from the skull proper. The feet are in all cases provided with five toes.

From the structure of the skull, as well as from certain features in the anatomy of the soft parts, it has been considered that the weasels are most nearly allied to the bears and raccoons; and it is best to place them in this position, as it simplifies classification. The evidence furnished by the numerous forms of extinct Carnivora discovered in the middle and lower Tertiary rocks of Europe and North America suggests that the nearest allies of the weasels are in reality the civets, and that the former group is the direct descendant of the latter. If this view be true the structural resemblance of the weasels to the bears and raccoons is an instance of parallel development, and indicates no near genetic connection between the two groups.

The family is very widely distributed, having representatives in all the great continents, with the exception of Australia. It attains, however, its maximum development in the temperate regions of the Northern hemisphere; and none of its members inhabits Madagascar. In regard to colouring there is a great amount of variation. Several of the northern forms have a dark summer and a light winter dress, and thereby differ from other Carnivora except the Arctic fox.

A large number of the martens and weasels and all the otters are clothed with fur of a nearly uniform dark tint, while one of the martens and some of the badgers are remarkable for their extreme brilliance. On the other hand, the American skunks and the Old World zorilles, together with the South African *Pacilogale*, are notable on account of their contrasting bands of black or dark brown and white, and thus form some of the most conspicuously coloured of all mammals.

It is also noteworthy that in the parti-coloured examples there is a great tendency for the under parts of the body to be darker than the upper; whereas the reverse is the case in the great majority of mammals.

This feature is especially well marked in the Indian and African rats. There is also a tendency for the different colours to arrange themselves in longitudinal lines or patches, or so as to make the whole of the upper surface of the body light and its under surface dark; and in no case are there either spots or transverse bands of colour, while equally noteworthy is the entire absence of alternating dark and light rings of colour on the tail.

In the case of the skunks it has long been recognised that the black and white colouring of the upper parts comes under the designation of warning coloration; that is to say, a conspicuous type of marking designed to proclaim that the owner is a noxious animal, not good to eat, and not to be approached with impunity on account of the vile odour it exhales when irritated.

Mr. R. I. Pocock, who has devoted special attention to the colouring of mammals, goes

much farther than this, and asserts that all species with white or partially white backs and black bellies are examples of warning coloration. And he justifies the assertion by pointing out that as a dark back and a white belly are definitely known to be developed to make the animals in which they occur inconspicuous or invisible, so the reverse of these conditions ought to be for the purpose of rendering the creatures in which they are developed as conspicuous as possible.

As the result of direct experiment, it has been ascertained that members of the present family with light backs and dark bellies are conspicuous by night as well as by day; and that none of them preys on active creatures the capture of which is difficult. It is also essential to the theory that such white-backed animals should be evil-smelling; and it has been ascertained that rats, grisons, and tayras have the power of emitting an unpleasant odour when they so desire, and also that the teledu, or Javan badger, is capable of stinking out a whole village.

In the case of the South African striped polecat and the South American striped weasel, however, it is possible that their colouring may respectively imitate that of their larger relatives the zorille and the grison.

The members of the weasel tribe include some of the most valuable fur-producers in the world, such as the sea otter (the most precious of all), sable, mink, ermine, marten, and wolverine or glutton.

The various members of the family are generally divided into three main groups, distinguished by the characters of their teeth and claws; these groups being the weasels, the badgers, and the otters.

TAYRA AND GRISON

The first representatives of the family are the peculiar Tropical and South American species respectively known as the tayra and the grison; but before describing these it is necessary to refer to the characters of the typical sub-family *Mustelinae*, in which the toes are short and only partially webbed, with short, sharp, curved, and in some cases partially retractile claws. The single upper molar tooth on each side is characterised by its narrowness from front to back, and its moderate dimensions. With the exception of the wolverine, all the members of this group are distinguished by their long and



THE SKELETON OF A WEASEL

TAYRA AND GRISON

weasel-like bodies and short legs, while all are terrestrial and arboreal in their habits. Exclusive of the members of the present genus and one South African species, the group is mainly confined to the northern parts of Europe, Asia, and North America, only two representatives occurring in peninsular India, Burma, and the Malay region, and one in South America.

The tayra and grison are collectively characterised by having a total of thirty-four teeth, of which $\frac{3}{4}$ are incisors, $\frac{1}{4}$ canines, $\frac{3}{4}$ premolars, and $\frac{1}{4}$ molars. Their skulls may be distinguished from those of martens and weasels by the tubercle on the inner side of the upper flesh tooth being placed near the middle of the tooth, instead of close up to its front edge. They walk to a great extent on the soles of their feet, which are completely naked, so that their feet are almost, but not quite, plantigrade. The claws cannot be retracted. The head is characterised by its breadth and flatness, and is furnished with very small and rounded ears. The tail varies in length from about one-half to three-quarters the length of the head and body.

The tayra (*Galictis barbara*) is the larger species, and may be compared in size to the otter, its total length being a little over a yard, of which rather less than half is occupied by the tail. The body and limbs are usually of a uniform dark brown colour, becoming almost black in some, while in others it is lighter. There is always a lighter spot on the chest. The head and neck are generally grey, but in some immature individuals they are nearly white, with the exception of the muzzle, which is dark. Occasionally, examples are met with in which the whole of the fur, except that on the muzzle, ears, and feet, is entirely white. The nose has a vertical groove at its extremity, the teeth are relatively large and protruding, and the aspect of the animal is ugly and forbidding.

The range of the tayra, inclusive of its local races, extends from Mexico in the north to the Argentine Pampas in the south. In British Honduras tayras have been observed hunting in companies of from fifteen to twenty, and although some writers have doubted the correctness of this statement, it is confirmed by Mr. W. H. Hudson in Argentina;

and they live both in open grass-clad country and in forest. Although largely nocturnal in its habits, the tayra will frequently hunt till midday, when it seeks its lair and reposes till evening. This lair is generally either the deserted burrow of an armadillo or some hole in a tree. This animal feeds chiefly on such mammals as agutis and other rodents, but it also eats birds and their eggs. In inhabited districts the tayra frequently raids poultry-houses, among the inmates of which it commits much havoc. Honey it also readily eats. The lair, which is sometimes made in the cavities of rocks, instead of in a hollow tree or deserted burrow, is constructed with much care. In one nest were found two young, which were quite blind and had much the appearance of young foxes.

The grison (*Galictis vittata*) is a smaller animal than the tayra, and may be compared in size to a marten or an Indian mungoose. It is distinguished by its relatively shorter tail, of which the length does not exceed half that of the head and body, and also by its colouring; the

latter being of that peculiar type already referred to, in which the under parts are much darker than the upper. The snout, the under surface of the neck, and the under parts of the body are very dark brown, whereas the whole of the upper surface, from the forehead nearly to the tip of the tail, is of a uniform bluish grey tint, the hairs being ringed with black and white. From the forehead to the shoulder the grey and brown areas are divided by a lighter band with a yellowish tinge, while the tip of the tail and the ears are distinctly yellow. There is no groove on the nose.

The grison is found over a great part of South America, as well as in Central America and Mexico. There are also two other species, namely, Allamand's grison (*G. allamandi*), ranging from Central America to Southern Brazil, which is of a larger size, but has the same general colouring, although presenting some approximation to the tayra, and *G. andina*, from Peru.

The general habits of the grison are very similar to those of the tayra. It is described as being the carnivore most commonly encountered on the coasts of South America, but is stated to be less frequent in Brazil than its cousin. By preference it selects the open country, although it may also be found in forests. It frequents plantations, and commits great depredations upon domestic poultry. Hollow trees, clefts in rocks, and deserted burrows are its favourite retreats; but it is said that, when hunted with dogs, the grison will never attempt to climb, and invariably takes shelter under rocks or beneath the roots of trees.

Fossil remains of various species of this genus have been found in the caverns of Lagoa Santa, in Brazil; while, what is more noteworthy, others have been obtained from the superficial deposits of the United States, thus indicating that the genus formerly

extended far to the north of its present limits in Mexico. It is therefore one of the comparatively recent immigrants into South America.

A remarkable little weasel-like animal from Patagonia, *Lyncodon patagonica*, the sole representative of its genus, should perhaps be placed in the neighbourhood of the tayra and grison. Possibly, however, it



THE TAYRA

is allied to the African striped weasel (page 512).

MARTENS, POLECATS, AND WEASELS

The martens and their near allies the polecats, stoats, and weasels constitute the typical group of the subfamily *Mustelinæ*. By many naturalists martens are separated from the polecats, and the latter from stoats and weasels. Regarding all these animals as constituting a single genus, the group may be characterised by the following features.

The number of teeth may either be the same as in the tayra, or there may be an additional premolar tooth on each side of both the upper and the lower jaw, thus raising the number to thirty-eight. The upper flesh tooth differs from that of the tayra in having the lobe on its inner side placed close up to its front edge. The lower flesh tooth of the martens and weasels is characterised by the small size or total absence of the cusp on the inner side of the second lobe of the blade; and as the heel at the hinder end is also rather small and furnished

with a cutting edge, the whole tooth consists of three main cusps, of which the two terminal ones are similar. Such a tooth is therefore totally unlike the lower flesh tooth of a civet. With regard to external characters, the martens and weasels are distinguished from the members of the preceding genus by their habit of walking almost entirely on their toes (digitigrade), and also by their short and compressed claws being capable of partial retraction. Their tails are either long or of medium length, and more or less bushy.

THE PINE MARTEN

The European pine marten, or yellow-breasted marten (*Mustela martes*), may be regarded as the typical representative of the martens, all of which have four pairs of premolar teeth in each jaw, while the flesh tooth of the lower jaw has a distinct cusp on the inner side of the second lobe of the blade. They are of comparatively large size, and may be compared in this respect to domestic cats. In all of them the body is much elongated, although to a smaller degree than is the case in the polecats and weasels. Martens are found only in the Northern Hemisphere, and range far northwards, one species, however, occurring as far south as India and the Malay region.

The martens constitute the sub-genus *Martes*, in which all the species are of large size, often with a light patch on the throat, but with dark under parts. They have one pair more of premolar teeth than polecats and weasels.

The pine marten has a total length of from 25 to 30 inches, of which from 16 to 18 inches are occupied by the head and body, and from 9 to 12 inches by the tail, inclusive of the hair at its extremity. As in the other members of this group, the muzzle is sharply pointed, with the nose extending a little beyond the lips; and the ears are thickly covered with hairs on both sides. Beneath the glossy outer fur there is a thick coat of under fur, and the soles of the feet have a dense layer of fur between the bare pads.

The pine marten is characterised by the rich brown colour of the fur, and the reddish grey tint and yellow tips of the under fur; the light-coloured fur on the throat and chest varying from yellowish white to bright orange. The range of this species includes a large portion of Northern Europe and Asia; and in former years the animal was common in the British Isles, where it is now restricted to the wilder districts. From the specific designation of this marten it would naturally be supposed that it exhibits an especial predilection for pine forests; but this does not appear to be the case, and it would seem that the name was given merely from the circumstance that pine forests are abundant in many of the districts which it inhabits.

In the midland and south-eastern counties of England the species became rare during the first half of the nineteenth century, and in most of them was exterminated before 1860, although isolated occurrences have been recorded since that date in Hertfordshire, Surrey, and Sussex. In Lincoln, Norfolk, and Suffolk it survived until the 'eighties, and there have been recent occurrences in Leicestershire. The Lake District and

the west of North and Central Wales are, however, apart from Scotland, at present the sole strongholds of the species in Great Britain. Many of the isolated occurrences of the species in England appear to be due to the remarkable degree to which the marten wanders.

Like other members of the group, pine martens (page 417) are mainly arboreal in their habits, and thereby differ markedly from weasels, which are more terrestrial. "Creeping from branch to branch in silent and stealthy pursuit of birds, squirrels, and other small animals," writes Professor T. Bell, "their sharp and long claws afford them a firm and secure hold of the bark, whilst the long and somewhat bushy tail must considerably aid them in maintaining their balance on the boughs; the

ears, too, are large and open, a circumstance which is of great advantage to them in discovering and pursuing their prey amidst the dense foliage in which they love to conceal themselves." Martens will, however, frequently descend to the ground, when they will destroy mice, rats, and moles, as well as rabbits and hares, and, it is said, even lambs. They are also deadly enemies to domesticated poultry of all kinds; while in the neighbourhood of the sea-coast they are also reported to feed on mussels. When domesticated, it is said on good authority that they will eat fruit.

Although it was long considered that the beech marten was also found in the British Islands, it is now ascertained that the present species is the only member of the group that has ever occurred there.

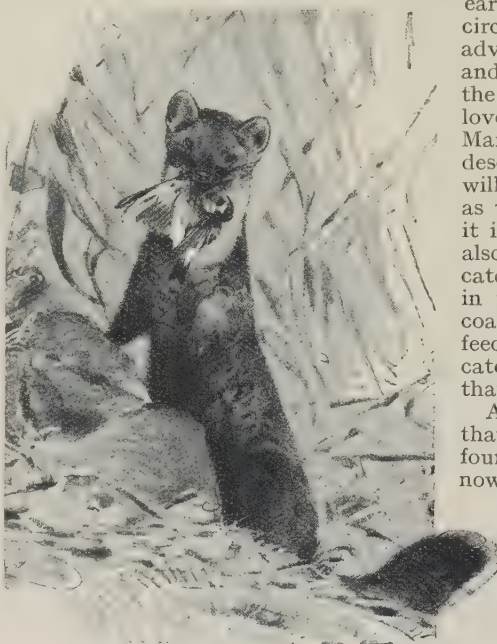
THE BEECH MARTEN

The beech, or white-breasted, marten (*Mustela foina*) is generally of a greyish brown colour, although the tint

may vary from whitish brown to deep blackish brown, with the tail and limbs darker than the body. The light area on the throat and chest, which may vary considerably in extent in different individuals, is always white; while the colour of the under fur varies from ashy to pure white. The skull is also proportionately wider than in the pine marten, and there are likewise certain characters in the teeth by means of which the one species can be distinguished from the other. The length of the head and body is about 18 inches, and that of the tail, with the hair at the end, 13 inches.

This species is a more southern form than the last, being widely distributed in Europe, but not reaching either the British Islands or Scandinavia, while eastwards it extends into Asia as far as Turkestan and the Eastern Himalaya. In the latter districts examples have been procured from Afghanistan in the west to Sikkim in the east, and also from Kumaun and Ladak; farther eastwards it appears to be unknown. Throughout the Himalaya it is generally found at considerable elevations, although descending as low as 5,000 feet in the Gilgit district. It inhabits the whole of Central Europe and Italy, the warmer parts of European Russia as far as the Urals, as well as the Crimea, the western and northern slopes of the Caucasus, Palestine, Syria, and Asia Minor, but appears to be unknown in Persia.

Over the great part of Europe the beech marten is commoner than the pine marten, which it exceeds in



THE PINE MARTEN

boldness of disposition. Although a frequenter of woods and trees, it is also found among rocks and stones, and hence receives its German name of *Steinmarder*.

In its mode of life the species closely resembles the pine marten. The nest, formed of hay and straw, is situated in a hole in a tree, in crannies between rocks, or in an old barn. The four or five young are born about April, and are blind for the first fortnight of their existence. Its wanderings at night during the summer are extensive, and no dove-cot, however lofty, or poultry-yard is safe when there is a marten in the neighbourhood. These martens feed on mice, rats, rabbits, and birds, and, when dwelling in woods, hunt and kill squirrels, lizards, and frogs. They likewise eat fruits of various kinds, such as cherries and plums; and in some parts of the Continent are considered to do so much harm to orchards that the stems of the trees are washed with tobacco juice or petroleum to prevent the martens from ascending. Like all its kindred, the beech marten is, for its size, an exceedingly bloodthirsty creature, and will often kill more than it can devour.

Although generally silent, in the pairing season, which takes place towards the end of February, or about three weeks later than that of the pine marten, these animals utter a kind of mewing sound not unlike that of a cat, and a pair of them in a tree may be heard for a considerable distance. In general the fur of this species is less valued than that of the pine marten; but some skins from Afghanistan and Turkestan have beautiful fur, with a long, glossy, nearly black pile, and very soft white or pale ashy under fur. These Turkestan martens were at one time regarded as belonging to a distinct species.

The inferiority of the fur of the ordinary beech marten, as compared with that of the sable, is due not only to its colour and actual length, but likewise to the relative length of the long pile as compared with that of the under fur, by which it is scarcely concealed.

The more northern skins are always superior to those from Southern Europe; and a large number are imported into England, and sold as an inferior kind of sable. Fossil remains of martens occur in the cavern deposits of the Continent; but only those of the pine marten have as yet been found in England.

THE SABLE

The sable (*Mustela zibellina*) is so nearly allied to the pine marten that some naturalists consider it merely as a variety distinguished by the greater length and fineness of the fur. It has, however, a much more distinctly cone-shaped head, larger ears, longer and stouter limbs, and proportionately larger feet. The fur should be thick, soft, and nearly uniformly coloured. Such skins are blackish above, having a mixture of black and grey on the snout, grey on the cheeks,

chestnut-brown on the neck and flanks, and orange-yellow, or sometimes reddish orange, on the throat. The margins of the ears are either greyish white or light brown in colour. In a number of cases there is a larger or smaller admixture of white hairs among the dark fur of the back, while the muzzle, cheeks, breast, and under parts are white. In other specimens the fur on the back is yellowish brown, while that of the under parts is nearly white, and only the legs are black.

Good skins should exhibit a kind of "watering," owing to the reddish tint of the woolly under fur showing through the long outer hairs. An average sable will measure about 20 inches from the snout to the root of the tail, the length of the tail being 7 inches. The skins are valued only when they have their winter fur, the summer coat being much shorter. In spring, although the winter fur may still be retained, the skins are useless, as the hair will drop off even after the skins have been dressed.

The range of the sable originally extended from the Ural Mountains to Bering Sea, and from the mountains on the southern borders of Siberia to 68° N. It is, however, much curtailed, owing to the incessant persecution to which the animal has been so long subject; and the chief haunts are now the mountain forests of North Asia, especially Eastern Siberia and Kamchatka.

Sable are for the most part of nocturnal habits, and, though they occasionally feed by day, generally spend that period of the twenty-four hours in holes at the roots or in the trunks of trees. They dislike the presence of man, and are rarely to be found in the neighbourhood of the villages, their favourite resort being the depths of the forest least frequented by the natives. The most inaccessible and least-known parts of the country are the best hunting-grounds. They live on hares, birds, and, in short, almost every living thing they can kill, but are also said to eat berries, and even fish. Indeed, there are apparently few animals that do not live on fish in Kamchatka. They have only one litter during the year, generally in April, and bring forth four or five young at a birth in nests in the holes of trees.

THE AMERICAN MARTEN

As the American marten (*Mustela americana*), of which there are several local races, differs from the Old World species in the shape and size of the last upper molar, which is large and irregular, it is generally regarded as a distinct species, although this may be doubtful. The typical race of this marten is small and pale-coloured, with the colour more or less uniformly brown, the breast-spot yellow, and the head and ears grey or whitish.

This typical race is found in the Hudson Bay district, Alaska, and other parts of North America, descending on the eastern side as far south as the Adirondack Mountains. The Newfoundland and Labrador martens are of darker colour, distinguished respectively as *M. a. atrata* and *M. a. brumalis*; while the



THE BEECH MARTEN

West American marten (*M. a. caurina*) is stated to come nearest of all to the pine marten. In the Adirondacks the American marten inhabits the evergreen forests, and is chiefly, although not exclusively, nocturnal. Its food consists of game-birds, hares and other smaller rodents, birds' eggs, young birds, frogs and toads, and large insects. It is said to display a distinct preference for forests of conifers, and is thoroughly arboreal, never venturing into the neighbourhood of human dwellings. Although generally gentle-looking, it is related that when attacking animals larger than itself, such as hares, it becomes as fierce in demeanour, in proportion to its size, as a tiger.

Curiously enough, at certain periods this species becomes exceedingly scarce; the periods of scarcity recurring with great regularity at intervals of about ten years. How the animals disappear is unknown, since there is no region into which they migrate without the knowledge of the hunter, and none is found dead. The best season for obtaining the skins is in November; the animals being caught in wooden traps, set in lines for miles across the country. In spite of the incessant persecution to which it is subject, this species has not appreciably diminished in number in the wilder regions of its habitat.

THE FISHER MARTEN

The largest of all the martens is the so-called fisher marten (*Mustela pennanti*), an animal known by a number of names—both popular and scientific—being variously designated as the "pekan," "Pennant's marten," "black fox," and "black cat." The last two titles are due to the large size, stout build, and dark colour of the animal, which in point of form may be more aptly compared to a fox than to a weasel. It measures from 24 to 30 inches from the tip of the snout to the root of the tail. The general colour is blackish brown, becoming grey on the head and neck, while the throat is distinguished by the absence of the light-coloured patch distinctive of all the other species.

The fisher marten ranges over the greater part of North America, as far northwards as Alaska and the Great Slave Lake; while southwards it is found in the upper part of Texas and about latitude 35°. Continual hunting, however, has exterminated it in the more settled districts of the United States east of the Mississippi. Though not known to catch fish for themselves, they are fond of fish, and never neglect to devour those that chance to fall in their way. They prey chiefly upon hares, squirrels, mice, grouse, small birds, and frogs, and are said to eat snakes. Porcupines also compose a portion of their food in some districts; specimens being sometimes killed with numbers of quills in their skin and flesh. Curiously enough, these needle-like quills, which often exceed 2½ inches in length, seem to cause it little or no inconvenience. Instances are recorded where the fisher marten has attacked and routed such a comparatively large animal as the raccoon.

In its chiefly nocturnal and largely arboreal habits the fisher marten resembles most of the other members

of the group. Its agility in the forests is very remarkable, and when much frightened, or in pursuit of prey, it has been known to leap from tree to tree. The nest is usually built in the hole of a tree at a great height above the ground; the young being generally from two to four in number, and produced at the end of April or the beginning of May.

THE INDIAN MARTEN

Readily distinguished from all the other species by its more brilliant colouring and the greater relative length of the tail, which is fully equal to two-thirds that of the head and body, the Indian marten (*Mustela flavigula*) is the handsomest of the group. The soles of the feet are at least partially naked, although this character is less marked in Himalayan specimens than in those from more easterly regions.

The fur is short, although longer in the Himalayan than in other examples, and has a thick, woolly under fur during the winter. There are several local races of this marten, some of which are more brightly coloured than others. In the common Indian type the upper part of the head and neck, the rump, the tail, and the limbs, are either glossy blackish brown or black; while the middle of the back is of a paler brown, sometimes with a whitish tinge. The chin and upper part of the throat are white, and the lower portion of the throat and chest either brilliant orange, brownish yellow, or pure yellow. In a second variety, with the exception of the white chin and throat and the pale yellow chest, the whole of the fur is dark brown.

The length of the head and body varies from 20 to 22 inches, and that of the tail, inclusive of the hair at the tip, from 17 to 20 inches.

The Indian marten is found throughout the Himalaya, from the regions to the west of Kashmir to Eastern Assam, and thence through the hilly districts of



THE SABLE

Burma to the Malay Peninsula and Sumatra. In peninsular India it occurs on the Nilgiri and Travancore Hills, while to the east its range extends as far as Southern China and Amurland. These martens are always found at a considerable elevation above the sea-level, ranging in the Himalaya up to seven thousand or eight thousand feet; and its occurrence in ranges so remote from one another as the Himalaya and the Nilgiris would seem to indicate a former colder condition of climate in order to have enabled the animal to have traversed the intervening hot districts.

This marten is only found where the hills are thickly clothed with forest, and is by no means exclusively nocturnal. Although apparently far from uncommon in the Himalaya, it is, according to my own personal experience, seldom seen. I had, however, once the good fortune to see a pair of these handsome animals descend from the trees, and gambol in a forest glade at a short distance from my position. Other observers state that they may sometimes be seen in parties of five or six, hunting for prey among brushwood or on the branches of trees. When on the move, they are continually uttering a kind of low chuckle, prolonged

POLECATS

into a harsh cry when they become excited. Their food, which includes large insects, appears to be very similar to that of the other martens, but they are reported to kill young deer.

It is noteworthy that a fossil marten, probably nearly allied to this species, occurs in the Pliocene



THE POLECAT

strata of the Siwalik Hills of Northern India, and is thus the oldest representative of the group yet known.

THE POLECATS

The well-known European polecat (*M. putorius*) is the first representative of the second great group of the genus *Mustela*, forming the subgenus *Putorius*, of which all the wild species are of medium size, with the under parts as dark as, or darker than, the back.

Apart from colour and size, the chief characters by which polecats, in common with weasels and stoats, are distinguished from martens are the absence of the first pair of premolar teeth in both jaws, the sharper cusps of the crowns of all the cheek teeth, and the absence of a cusp on the inner side of the blade of the flesh tooth in the lower jaw. The members of this group have, as a rule, longer bodies and proportionately shorter legs than martens, and, whereas the latter give but little smell, the polecats are of

ill reputation in this respect, as testified by the old name of foumart (foul marten) applied to the British species. This evil smell is often correlated in the polecats with the conspicuous light-backed and dark-bellied type of colouring (page 502).

In length the head and body of the polecat usually measure about 17 inches, while that of the tail is 6 inches. The nose is rather sharp, the small ears are rounded, the neck is relatively long, and the tail bushy. In colour the long hair of the body and limbs is brownish black or black, and darkest on the head, tail, feet, and under parts; while the ears are white, and there are some brown and white markings on the face and mouth. The woolly under fur is pale yellow or tawny, and by showing through the long hair communicates a general brown tinge, mingled with yellow, to the whole coat, of which the tint varies considerably in different individuals. The fur is very long and loose on most parts of the body, and is commercially known as "fitch," from the local name fitchet, or fitcher.

The range of the polecat includes the greater part of Europe, extending as far northwards as the southerly districts of Sweden and the White Sea, but not including the Mediterranean countries. In Western and Northern Asia it is replaced by the closely allied Siberian polecat (*M. eversmanni*), which appears to be distinguished mainly by the head and back being nearly white, and by certain differences in the form of the skull. A third nearly allied kind is the Tibetan polecat (*M. larvata*), inhabiting Ladak and Tibet, which differs only from the last by certain features in the base of the skull.

The Sarmatian polecat (*M. sarmatica*), however, is a very distinct species, of rather smaller size than the common European kind, and distinguished by the fur of the under parts being of a glossy black; while that of the upper parts is a mixture of brown and yellowish white. This species, often known as the mottled polecat, presents, therefore, another instance of the peculiar distribution of dark and light colours. It is found in South-Eastern Europe, northwards from Poland, whence it extends into Western Asia, where it is common in the neighbourhood of Kandahar.



THE SARMATIAN POLECAT

Another species is the American, or black-footed, polecat (*M. nigripes*), which is generally brownish white, with the feet, the tip of the tail, and a broad stripe across the forehead black. It is larger than the common species, the length of the head and body measuring 19 inches, and that of the tail, with the hair at the end, 5½ inches. It inhabits the central plateau of the United States, ranging as far south as Texas.

The habits of all the species of polecats are very similar, and the whole are characterised by their extremely fetid odour. From the barren nature of the country which it inhabits, the Tibetan polecat, however, probably dwells among rocks and stones; while the Sarmatian species generally resides in the deserted burrows of other animals.

The common polecat is chiefly a nocturnal animal, lying concealed during the day, and issuing forth at evening for its devastations. In winter it frequently seeks shelter in old farm buildings. It is far less arboreal in its habits than the martens, and less active in its ways. The polecat is a deadly enemy to hares, rabbits, partridges, and all kinds of domesticated poultry, from the pigeon to the turkey; while it also consumes eggs, lizards, snakes, and frogs. It is stated on good authority that it always carries away its food to its lair; this, however, would be obviously impossible with such large birds as geese and turkeys, which are, perhaps, merely killed from that insatiable thirst for blood which is its characteristic. Indeed, wherever a polecat gains access to a poultry-house, the owner will be pretty sure to find the majority of the occupants lying dead in the morning. The destruction which it occasions among the eggs and young of pheasants and partridges, young hares, and rabbits is incalculable.

Fortunately, its numbers in England have been greatly diminished, and it is now chiefly confined to regions with thick woods affording comparatively inaccessible retreats. In the Alps it wanders in summer far above the limit of trees, although retreating to lower elevations in winter. The nest of the polecat is made in a deserted rabbit-hole, in the crevices of rocks, or amongst heaps of stones overgrown with brushwood or weeds; and here the young are born in April or May, or, more rarely, the beginning of June. The number in a litter may vary from three to eight, although it is more usual to find four, five, or six. When captured early, the young may be easily trained for the purpose of rabbit-catching. Fossil remains of the polecat, like those of the weasel and the stoat, have been obtained from the cavern deposits of England and the Continent, in association with the bones of extinct mammals. A number of other polecats have received distinctive names.

The ferret, which is a domesticated breed of the polecat, modified by captivity, is usually smaller and more slender, and generally of a yellowish white colour, with pink eyes; but there is also a brown variety known as

the "polecat ferret," due probably to crossing with the wild stock. Ferrets are bred chiefly for rabbit and rat hunting. Although they learn to know their masters to a certain extent, they are untrustworthy, and should be handled with caution. The ferret has no strong local attachments, and therefore requires to be strictly secured; and it is also very susceptible to cold. As is the case with many domesticated animals, ferrets

are more prolific than their wild allies, the number in a litter varying from five to ten. The young are born in the spring, but there may sometimes be two litters in a year.

THE MINKS

The mink forms one of a group of three species of comparatively large size, whose nearest allies are the polecats. The European representative of this group (*M. lutre-*

ola) is generally known on the Continent as the nertz, or sumpt otter (marsh otter), and has no recognised English title. The second species is the true mink (*M. vison*) of North America; while the third is the Siberian mink (*M. sibirica*), which is stated to connect the other two with the polecats. These three are distinguished from the other members of the genus, not only by their semi-aquatic habits, but by certain structural peculiarities. While agreeing with the polecats in the number of their teeth and general type of colouring, the minks differ from these, as well as from the weasels, in the narrower muzzle to their skulls, being thus more like the martens. The premolar teeth are relatively larger than in their nearest allies, but a more important point of distinction is afforded by the partial webbing of the toes, which are also peculiar in possessing no long hair between their naked pads.

The European and North American minks are such closely allied animals that they cannot be even distinguished from one another externally, and it would accordingly seem better to regard them as mere local varieties of a single species, although it is not the general practice. The European mink has usually a white upper lip, which is rarely exhibited in its American relative, and in the American form the upper molar tooth is decidedly larger than in the European.

Like the martens, the mink has a uniformly long and somewhat bushy tail, differing markedly from that of the weasels, its whole length being approximately equal to half that of the head and body. The ears are smaller than in any of the allied forms, and scarcely appear above the general level of the fur. The coat consists of a dense, soft, and matted under fur, mixed with long, stiff, and glossy hairs, the gloss being most marked in the fur of the upper parts, while the hairs of the tail are more bristly than elsewhere.

In colour the mink varies from light, dull yellowish brown to deep chocolate-brown; the ordinary tint being rich dark brown, scarcely, if at all, paler below than above. The tail is always decidedly blackish.



THE FERRET

THE WEASEL

In both the Eastern and Western forms the chin is invariably white, although the extent of the white area is subject to individual variation. In addition to that on the chin, there may be small irregular patches of white on the under parts; while, as a rare abnormality, the tail may also be tipped with white.

As a rule, the American is somewhat larger than the European mink, and in both the male is always larger than the female. The American form, from the tip of the snout to the root of the tail, may vary in length from 15 to 18 inches; while the length of the tail, inclusive of the hair, ranges from about 8 to 9 inches. The European mink is an inhabitant of Eastern Europe, occurring in Poland, Finland, and the greater part of Russia, although unknown to the east of the Ural Mountains. The American species ranges over the greater part of North America, although not found in the extreme north.

In its habits the mink, in both hemispheres, is amphibious, and is therefore only found in districts where water is abundant. Its food consists of various aquatic creatures, such as frogs, crayfish, and mussels; but it will also eat various small aquatic mammals, such as field mice, as well as mice and rats; while in America it is reported to prey at times upon the comparatively large musquash. Marsh-frequenting birds, too, fall victims to the mink, and their eggs are probably also consumed. Other wild birds, however, are comparatively safe from the attacks of this animal, as its climbing powers are of the feeblest. Poultry are not infrequently attacked, but the mink does not exhibit the wholesale destructiveness characteristic of the stoat. The mink has been often observed to pursue its prey entirely by scent, and may be seen hunting both by night and by day.

The nest of the mink is situated either in a hole in the river or lake bank, or in a hollow log, and is well lined with feathers and other soft substances. The usual number of young in a litter is from four to six; and in the Adirondack region these are born early in May, and remain with the female until the following autumn. In America minks have been extensively bred in a semi-domesticated state for the purpose of being used as ferrets; and in this condition the number of young in a litter may vary from three to as many as ten. The scent characteristic of all the members of the weasel group is extraordinarily developed in the mink, no American animal, with the exception of the skunk, possessing such a powerful, penetrating, and lasting effluvium.

All who have hunted the mink bear witness to its extraordinary tenacity of life, Dr. E. Coues stating that he has known several instances of these animals being found alive after having lain for fully four-and-twenty hours with their bodies crushed flat beneath heavy logs. The countenance of the mink is described as at all times far from prepossessing, but when caught alive in a steel trap these animals are said to have an expression almost diabolical.

Some years ago the fur of the mink was little

esteemed, and the price was at one time said to be so low as not to repay the cost of transport. Mink fur, however, is now more appreciated, and the animal has consequently been more vigorously trapped, with the result that in some districts there has been a considerable reduction in its numbers, and a corresponding increase in the value of skins, although the price fluctuates either according to demand or the caprice of fashion. American mink obtains higher prices than Russian, the best skins coming from Alaska and New England.

The Siberian mink is a little-known species inhabiting the districts eastwards of the Yenisei River, but unknown in Europe. It is more like a polecat in appearance, having similar dark and light markings on the head and face. The colour is a clear rich tawny or fulvous brown, as dark below as above.

THE WEASEL

The European weasel (*Mustela nivalis*, or *M. vulgaris*) is the first of several species distinguished from the polecats by their smaller size, longer bodies, the much slighter development of the ridges and crests on their skulls, and their white or yellowish under parts, which are thus lighter than the back. They form the typical section of the genus *Mustela*.

The weasel, which ranges over the whole of Europe, Northern and Central Asia, and a large portion of the northern part of America, varies from 6 to 8 inches in length from the tip of the snout to the root of the tail; the tail itself, with the hair at the end, varying from 2 to 2½ inches. In colour the under parts are usually some shade of mahogany brown in summer dress, while the throat and under parts are white, without any tinge of yellow. The outer sides of the limbs are coloured like the back, but the feet may be either of the same tint as the back or as the under parts. There is considerable variation in the shade of the brown as there is, too, with regard to the limits of demarcation between the brown and the white areas. The tail is cylindrical and pointed, with its tip nearly or exactly the same tint as the back. The female weasel is considerably smaller than the male, and appears to be the animal locally known as the cane.

In the northern parts of the whole extent of its range the weasel assumes a white dress in winter,

although this change of dress is less regular than in its cousin the stoat, and requires a greater intensity of cold for its production.

The change occurs but rarely in the British Islands. Even in the winter dress, the tip of the tail, although paler than at ordinary times, retains the reddish brown colour. In North

America the weasel turns white in the northern parts of New England and the Adirondack Mountains, but in the latitude of Massachusetts retains the dark colour throughout the year. American naturalists regard the North American weasel as a distinct species, under the name of *M. novæboracensis*.

The weasel, in suitable localities, may be found almost everywhere—in hedgerows, woods, among stones,



THE EUROPEAN MINK

in watercourses, and along the edges of swamps. Its food consists of small creatures, such as mice, rats, small birds, moles, shrewmice, insects, and so forth; but there is no doubt that it will occasionally make inroads on poultry, and sometimes attack rabbits and sleeping partridges. The accusations of habitually killing rabbits and hares so frequently levelled against the weasel should, however, in most cases be transferred to the stoat. Indeed, from the war incessantly waged by the weasel against rats, mice, and field mice of all kinds, it ought to be protected by the farmer, if not also by the gamekeeper, rather than ruthlessly destroyed. In spite, however, of these services, the weasel does sometimes take to rabbit-hunting in good earnest; and several will combine in companies the better to effect their object.

In all cases the weasel is a bold and inquisitive animal, exhibiting little fear of man, and poking out its nose from some hole or cranny to survey his proceedings with the greatest indifference and self-possession. In spite, however, of this curiosity, the weasel is ever on the alert to withdraw its head at the slightest symptom of attack. When on the ground, weasels generally proceed in a series of small leaps, stopping at intervals to take a careful survey of their surroundings, and not infrequently raising themselves on their haunches in order to obtain a better view. From its elongated, almost snake-like body the weasel can follow most of the smaller mammals on which it preys into their holes or hiding-places. It is also an expert climber, seizing hen birds while sitting on their nests, and thus gaining both parent and offspring, or eggs, at a single stroke.

Although probably more prone to wander by night than by day, it can scarcely be regarded as a nocturnal creature, and may, indeed, be frequently observed hunting by day. The weasel brings forth four or, more frequently, five young, and is said to have two or three litters in a year. The nest, which is composed of dry leaves and herbage, is warm and dry, being usually placed in a hole in a bank, a dry ditch, or a hollow tree. As is well known, the female weasel will defend her helpless young with great fury and desperation, risking her own life freely rather than leave them. Occasionally the male will join in endeavouring to protect or carry off the young from danger.

THE STOAT, OR ERMINE

The stoat, or, as it is generally called when in winter dress, the ermine (*Mustela erminea*), is closely allied to the weasel, from which it is chiefly distinguished by its superior size and the black tip to the tail, which retains its colour when the rest of the fur turns white. On account of its superior size the stoat is sometimes known as the greater weasel. In summer the colour of the fur of the upper parts of the stoat is dull mahogany brown, while the under parts are of a pale sulphur yellow, and are thus easily distinguished from the pure white of the weasel. The length of the head and body is usually from 9 to 10 inches, but may occasionally fall so low as 8 inches, or reach to 11; the length of the tail,

with the hair, varying from about 3 to 5 inches. The distribution of the stoat is nearly the same as that of the weasel, the animal being widely spread over the northern regions of both hemispheres; it is, however, not improbable that the stoat extends into portions of the Western Himalaya, where its cousin is unknown. In all the more northern parts of its habitat the stoat invariably assumes the well-known white winter dress which constitutes the valuable ermine of commerce (page 115). In the British Islands this



WEASELS HUNTING

change always takes place in the Highlands of Scotland; while in the northern English counties, like Northumberland and Durham, it is frequent, but by no means universal. Proceeding farther south, the change of colour becomes more and more rare, taking place only occasionally in counties like Cambridgeshire and Lincolnshire, while in Cornwall and Hampshire it is almost unknown. In North America the change takes place in the

more northerly of the United States and all the regions to the north. Several local races, often regarded as species, occur in America; and the Irish stoat (*M. erminea hibernica*) is also a distinct race, with the under parts approximating in coloration to those of the weasel.

The stoats of the islands of Jura and Islay, contrasted with those of the mainland, are characterised by their inferior size, relatively longer tails and ears, and certain peculiarities in the skull. These features are most marked in the Jura examples; those from Islay being somewhat larger. The occurrence of a stunted race of stoats in these islands with relatively large ears might be accounted for if food were scarce and good hearing an important aid in the capture of scanty prey. The increased length of tail is less easy to explain. These stoats apparently indicate a distinct local race of the species.

The nature of the change from the dark summer to the white winter dress in the stoat and other animals has given rise to much discussion. It was originally considered that the animal sheds its coat in the autumn and spring; the dark summer coat being gradually replaced by the advent of the white hairs of the winter one. Doubts then arose whether the change in colour was always coincident with the development of the winter and summer coat, and whether the hairs themselves might not actually change colour.

Dr. Elliott Coues, however, succeeded in proving that the change might take place in either way, some specimens taken in spring showing the long, woolly white winter coat on some parts of the body, while on other parts they had the short, coarse, brown hair of summer; and he observes that "we may safely conclude that if the requisite temperature be experienced at the periods of renewal of the coat the new hairs will come out of the opposite colour; if not, they will appear of the same colour, and afterwards change; that is, the change may or may not be coincident with the shedding."

Dr. Coues attributed the reason of the colour-change entirely to the effects of temperature; but strong

THE STOAT, OR ERMINE

objection is taken to this view by Dr. Hart Merriam, who observes that it occurs in captive specimens kept continually in warm rooms. Dr. Merriam relied, however, chiefly upon the fact that among the stoats of the Adirondack Mountains the winter change never takes place till after the first fall of snow, towards the end of October or the beginning of November. Although the temperature of the air may be much lower before than after this first snowfall, yet it is true "that ermine caught up to the very day of the first appearance of snow bear no evidence of the impending change. Within forty-eight hours, however, after the occurrence of the snow-storm the coat of the ermine has already begun to assume a pied and mottled appearance, and the change now begun progresses to its termination with great rapidity. In early spring, the period for the reversal of this process, the changing back from the white coat of winter to the brown summer coat is determined by the same cause—the presence or absence of snow."

These arguments appear conclusive that the change is really due to the necessity of the colour of the animal being adapted to its external surroundings; the change in captivity being owing to the influence of hereditary habits, which cannot be overcome in the short period during which the animals were under observation.

In habits the stoat is in general very similar to the weasel, although from its larger size and greater strength it commonly attacks bigger animals, such as hares, rabbits, and poultry. In America it is very fond of the ruffed grouse, and will often overcome the large northern hares, while one has been known in a single night to slay upwards of forty well-grown fowls. When food is abundant, the stoat only sucks the blood or eats the brains of its victims, leaving the flesh untouched. Stoats usually hunt in couples, although occasionally three may be seen together, and their range of destruction seems only to be limited by their strength.

The stoat hunts its prey both by day and by night, and is fully as good a climber as the weasel. Although it cannot in any way be considered an aquatic animal, there is good evidence to show that it is an excellent swimmer, and will, when occasion arises, take readily to the water. Its favourite haunts are stony places and thickets, which secure it a safe refuge from foes; and it is also very partial to patches of impenetrable gorse, while it will sometimes take up its abode in a deserted rabbit burrow. In spite of its destructiveness to poultry and game of all kinds, the stoat is a benefactor to the farmer, from the number of rats, mice, and field mice it consumes; and it is a remarkable fact that, whenever unusual numbers of any of these rodents have

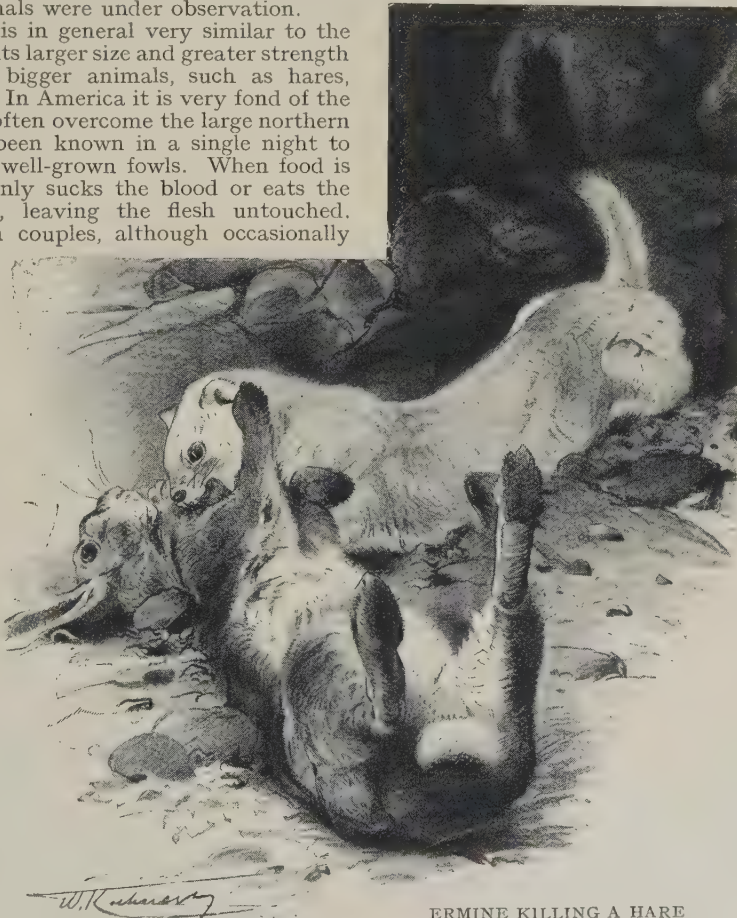
appeared in any district, they have almost invariably been followed by a large assemblage of stoats and weasels to wage war upon them. When angered, the stoat emits a most noisome and penetrating smell.

The young in England are generally produced during the months of April and May, in a nest constructed in a hole in some dry bank. Professor Bell states that the usual number of young in a litter is five, but Dr. Coues asserts that the number may vary from a pair to as many as a dozen, although five or six may be taken as the average. In America the stoat has occasionally been employed in the same manner as the ferret for rabbit-catching, and appears to take to the work readily. In most parts of England stoats are less common than weasels, although the reverse is stated to be the case in Scotland.

The fur of such examples as assume in Britain the white winter dress is always far inferior in quality to that of skins obtained from more northerly regions; the inferiority consisting in the shorter and thinner hairs, and the less pure and bright tint of the whole coat. The importation of ermine skins into England was formerly very large, but, owing to depreciation in value, it was found that in some years they

were not worth the trouble of collection. At the present day the ermine is much more abundant in British North America and Alaska than in the United States, the largest number of skins being obtained from Alaska.

In addition to the weasel and stoat, there is a number of more or less closely allied species inhabiting the Northern Hemisphere, while a few occur south of the equator. In North America the long-tailed stoat (*M. longicauda*), inhabiting the region of the Upper Missouri, is distinguished from the ordinary stoat by its longer tail. The Brazilian, or bridled weasel (*M. frenata*) is a more southerly species, ranging from Texas to Brazil, and characterised by the head being darker than the body and blotched with white, and also by the retention of the



ERMINE KILLING A HARE

dark colour throughout all the seasons of the year.

Asia also possesses a number of representatives of the group, such as the Himalayan weasel (*M. hemachelana*), in which the under parts are brown and the tip of the tail dark; the striped weasel (*M. strigidosus*), of Sikkim, in which there is a pale stripe

down the back; the yellow-bellied weasel (*M. calhia*), from the Central and Eastern Himalaya; the pale weasel (*M. alpina*), ranging from the Altai to Gilgit; as well as several others, some of which are confined to Tibet. Weasels were also well represented in past epochs of the earth's history, the remains of numerous species having been described from the Miocene Tertiaries of Europe. Of those referred to the existing genus *Mustela*, some differ from living weasels, and thereby agree with the larger martens, in having four pairs of premolar teeth in both jaws; while others have four pairs of these teeth in the upper jaw, and only three in the lower jaw; and others, again, have the reverse of this arrangement. Another extinct weasel-like animal from the same deposits, for which the name *Plesictis* has been proposed, is one of the forms apparently connecting the weasels with the civets.

STRIPED WEASEL

The pretty little South African striped weasel (*Pacilogale albinucha*) is worthy of a separate heading, not only on account of its remarkable colouring, but also as being, with the exception of one species belonging to the typical genus *Mustela*, the sole representative of the weasels in Africa south of the Sahara. This species is distinguished from all other weasels by having the ground colour of the fur black, with the upper part of the head and neck white, and four pale brownish white stripes running along the back; the tapering tail being white.

This peculiar colouring of the striped weasel is almost precisely similar to that of the zorilles, and may be another instance of true mimicry among mammals. In addition to its colouring, the species is also distinguished by having only two pairs of premolar teeth in each jaw, while very generally there is but a single pair of molar teeth in the lower jaw. Possibly this remarkable animal should be placed next to the zorilles.

GLUTTON, OR WOLVERINE

The glutton (*Gulo luscus*), which is the only representative of the genus to which it belongs, is a very different-looking animal from any of the foregoing, from which it is likewise distinguished by its superior dimensions. In spite, however, of these differences, naturalists are in accord in regarding the glutton—or, as it is called in America, wolverine—as a member of the typical or weasel-like section of the family.

The glutton, which is an inhabitant of the northern regions of both the Western and Eastern Hemispheres, has the same number of teeth as in the martens; but these are unusually large and powerful, and distantly recall those of the hyænas. The animal is heavily and rather clumsily built, and walks with the greater part of the soles of the feet applied to the ground. The limbs are thick and rather short; the feet, which are provided with long, curved, and compressed claws, have their soles thickly haired. The back is much arched, and both the head and tail are carried low. The head is broad and rounded, with a rather short and

pointed muzzle, small and widely separated eyes, and small rounded ears, projecting little above the general level of the fur. The tail is comparatively short, thick, and bushy, with hairs varying from 6 to 8 inches in



AFRICAN RATEL

length, and has somewhat the appearance of having been truncated at the end. The fur of the body and limbs is rather coarse, long, and thick, and there is also a thick, woolly under fur.

The general colour of the glutton is dusky or blackish brown; but there is a distinct band of chestnut, or some lighter tint, beginning behind the shoulders, then running along the flanks, and meeting its fellow at the root of the tail. The front and sides of the head are light grey, but upon the throat and chest there may be one or more light spots. The limbs and under parts, together with most of the tail, are very dark. The claws are nearly white. There is considerable variation in the size of the glutton, the length of the head and body in seven examples measured by Dr. Elliott Coues varying from 26½ to 36 inches; and that of the tail, with the hairs at the end, from 12½ to 15 inches.

In Europe the glutton was long regarded as a kind of fabulous creature, and it is remarkable that it is known by the same name—*vielfrass*—in almost all continental countries. What may be the meaning of this name is uncertain; some writers considering that it is compounded of two Swedish words signifying "rock cat," while others refuse to admit its Scandinavian origin. By the French Canadians the animal is termed *carcajou*, and by the English residents of British North America *quickhatch*; the latter, and probably also the former, being derived from some almost unpronounceable native name.

The glutton is a forest-haunting animal, and in America once ranged from about 35° N. to about 75° N., but has been virtually exterminated throughout the United States. In Europe the glutton is still found in Norway, Sweden, Lapland, and Northern Russia, and also inhabits Siberia and Kamchatka. In former days it was found in Lithuania, where it is now extinct. At an earlier period of the earth's history the glutton ranged to the British Isles, its fossilised remains having been discovered in the caverns of Derbyshire, Glamorganshire, and the Vale of Clwyd, while they also occur in the older Forest-Bed of the Norfolk coast. Evidence of the former existence

RATELS

of the glutton on the Continent has been obtained in the caves of the Dordogne in the south of France.

In habits the glutton is almost exclusively nocturnal, there being few instances of its having been seen abroad during the day; and in two of these cases the animal was observed to sit up and shade its eyes with its paws, as if suffering from the unaccustomed light. The glutton does not hibernate, and there is no marked difference in the colour of the winter and summer coat. In spite of its clumsy-looking appearance, when disturbed it can make off at a very rapid pace, and hunters who have occasionally seen a glutton in the shades of evening speak of the hopelessness of pursuit. It ascends rough-barked trees with facility, although it is said that its climbing powers are only exerted when it scents food. In the chase of prey the glutton will readily swim rivers. As a rule it is silent, although when attacked it will give vent to angry growls.

Gluttons are found either solitary or in pairs, but generally solitary. During the day they live concealed in subterranean holes, which are usually their breeding-places, and are frequently the deserted lairs of bears. In North America the young are born in June or July, the number in a litter being four or five, although it is stated that there is sometimes only a pair. The young remain with their mother till the following winter, when they have to shift for themselves. The Cree Indians say that the mother is exceedingly fierce when defending her offspring, and at such times will not hesitate to attack human beings.

In regard to food, the glutton will devour any animal that it can catch and overmaster, and is by no

their burrows and eaten. Although much exaggerated by the older writers, the voracity of the glutton is extreme.

Gluttons are in the habit of robbing the traps set for other animals, and when one of them has discovered a line of marten traps the trapper may as well relinquish his quest until he has destroyed the marauder. Every trap along the line will be pulled to pieces and the bait or captured marten removed; while, after the hunger of the glutton is satisfied, the remainder of the booty will be buried. Another curious propensity is the habit of stealing and hiding articles which can be of no possible use to it; and one instance is recorded where these animals removed and concealed the whole paraphernalia of an unoccupied hunter's lodge, including such articles as guns, axes, knives, cooking vessels, and blankets.

RATELS

The ratels, or, as they are frequently called, honey-badgers, are distinguished from all the members of the family hitherto noticed by their more badger-like shape, very short tails, and the absence of external ears. They were at one time classed with the badgers, but from the resemblance of their colouring to that of the grisons and the form of the upper molar tooth they appear to be members of the weasel group, specially modified for a burrowing existence. Four living species have been named, one of which is confined to India, while the others are African.

In addition to their short tails and the absence of external ears, ratels are characterised by their stoutly built, badger-like bodies and short, powerful limbs,

of which the front pair are provided with enormous claws. They walk with the greater part of the naked soles of the feet applied to the ground. As regards colouring, they show in a most marked degree the peculiarity already referred to as distinguishing many members of the family; that is to say, the under parts are dark and the upper parts lighter. In the present instance the whole of the muzzle, together with the under parts of the head, body, and tail, and the entire limbs is black; while the upper portion of the head, body, and fore half of the tail are whitish grey.

The skulls of the ratels may be distinguished by the small number of the large and powerful teeth. The total number is only thirty-two, there being but three pairs of premolar teeth in each jaw, and no tubercular molar in the lower jaw behind the flesh tooth. Ratels may be compared in size to a badger, the length of the head and body of the Indian species varying from about 26 to 32 inches, and that of the tail, inclusive of the hair, from 6 to 6½ inches.

The Indian ratel (*Mellivora indica*) is found from the Himalaya to Cape Comorin, but is unknown in Ceylon or eastwards of the Bay of Bengal. The typical African species (*M. ratel*) occurs throughout Africa, but more especially in the southern and western parts of the continent. Dr. W. T. Blanford has expressed some doubts whether the African and Indian ratels are really entitled to be

regarded as distinct species; the former being chiefly distinguished by the presence of a well-marked white line dividing the dark area of the under parts from the grey of the back. A black ratel (*M. cottoni*) has been described from the Congo Forest; and if this blackness be constant, it would appear to be an adaptation



GLUTTONS, OR WOLVERINES

means averse from carrion. Its activity is such that it can at times capture such nimble prey as hares and grouse, while disabled or weakly deer are always successfully attacked. The stories of its attacking healthy full-grown reindeer, however, are improbable. Foxes, rabbits, marmots, and the like, are dug out from

to existence in the gloom of the forest, when the ordinary conspicuous type of colouring would be useless.

Ratels are strictly nocturnal in their habits, and reside during the day in burrows, which are probably excavated by themselves. The Indian species is most commonly met with in hilly regions, or along the high-scarped banks of the great rivers, which afford good situations in which to construct its burrows. Ratels generally go about in pairs, and feed on rats, birds, frogs, insects, and honey; while in cultivated districts they commit frequent raids on poultry. The African species, which exhibits a very strongly marked taste for honey, together with the larvæ of bees in the combs, digs out the latter from hollow trees by the aid of its powerful front claws. Early accounts of the ratel's mode of operations when about to attack a bees' nest are not, however, to be wholly relied upon, since they are largely drawn from native sources of information.

In captivity ratels are easily tamed, and frequently exhibit a peculiar habit of turning complete somersaults each time they walk up and down the cages in which they are confined.

From the rocks of the Siwalik Hills of North-Eastern India, belonging to the Pliocene period, and likewise from formations of corresponding age in the Punjab, have been obtained the remains of ratels closely allied to the living species, suggesting that India may have been the original home of these animals, and that they migrated thence into Africa.

SKUNKS

The handsome but ill-savoured skunks belong to the second sub-family group (*Melinae*) of the *Mustelidae*, which includes the skunks, badgers, and their allies, and is characterised as follows: The feet are long, with straight toes, and the claws are blunt, but slightly curved and compressed, and incapable of retraction; those of the fore feet being remarkable for their large size. The molar tooth of the upper jaw is somewhat variable in shape, but is generally very broad, so that it often presents an oblong form. Most of the members of this group are terrestrial and fossorial in their habits.

The skunks, of which there are several species, are exclusively American, the typical forms being referred to the genus *Mephitis*, while the smallest species represents the genus *Spilogale*, and the white-backed South American forms are classed as *Conepatus*.

The more typical species have thirty-four teeth, of which $\frac{3}{4}$ are incisors, $\frac{1}{4}$ canines, $\frac{3}{4}$ premolars, and $\frac{1}{4}$ molars; and all are easily recognised by the large bushy tail and the general black colour variegated with white stripes on the back.

The typical skunk (*Mephitis mephitis*) is an inhabitant of North and Central America, ranging from Hudson Bay to Guatemala, and may be compared in size to a rather small cat, the length of the head and body always exceeding a foot, although there is considerable local variation in this respect. It is a stoutly built animal, with a small head, short and rounded ears, a moderately elongated body, and legs of medium length; the mode of walking being partially plantigrade.

The long and bushy tail is thickly clothed with very long and fine hair, and generally carried curled over the back when the animal is walking; its length, inclusive of the hair, being somewhat less than that of the head and body. The moderately long hair of the body is black or blackish; and, although there is a great amount of local variation, the white markings usually take the form of a streak on the forehead, a spot on the neck, and two stripes running down the back. The tail is black, more or less mixed with white, or merely tipped with white. In some cases the white stripes do not extend beyond the neck, so that the back is entirely black. The nearly allied long-tailed skunk (*M. macrura*) from Mexico differs by its longer and more bushy tail, of which the whole length is not less than that of the head and body.

The second genus is represented by the lesser skunk (*Spilogale putorius*); the members of this group ranging from the southern United States to Yucatan and Guatemala. The lesser skunk never exceeds a foot in length from the snout to the root of the tail, the whole tail being distinctly shorter than the head and body. It has four interrupted white stripes on the body, together with some spots, and the tail is tipped with white. There are also certain differences in the characters of the skull.

In South America the group is represented by several



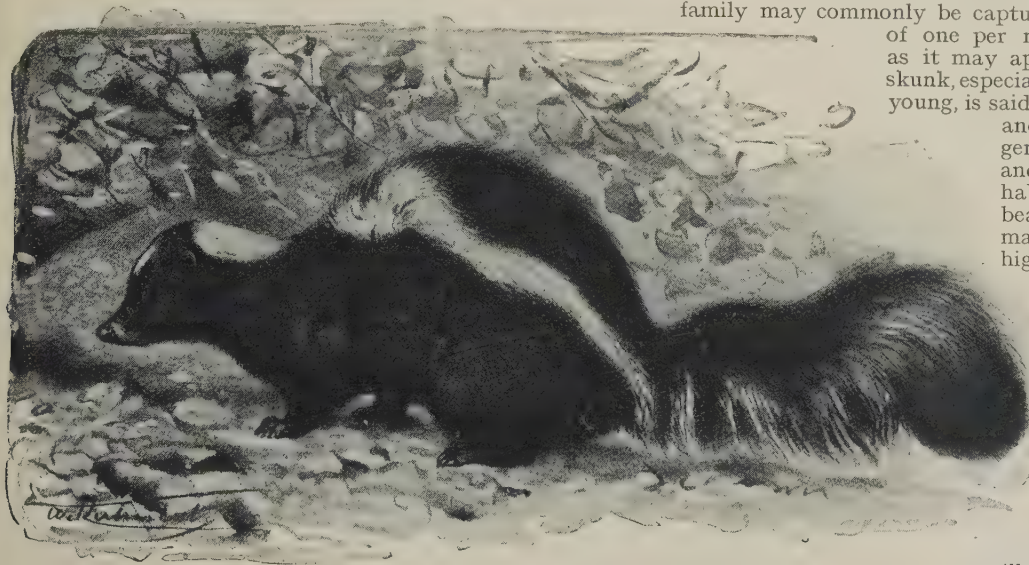
WHITE-BACKED SKUNKS

species, among which is the white-backed skunk (*Conepatus mapurito*). These skunks differ from the others by their heavier build and more pig-like head and snout, in which the nostrils are directed downwards and forwards, instead of laterally. There are, moreover, important differences in the form of the skull and teeth, the latter being usually only thirty-two in number, owing to the absence of the first pair of premolars in the lower jaw. Then, again, the ears are extremely small, and the tail is shorter and less bushy than in other skunks. In size these species are the largest of the group, some specimens attaining a length of about 24 inches, exclusive of the tail, although the more usual dimension is about 18 inches. The pattern of the black and white varies considerably in the different species; in some cases the two white stripes on the back are very

THE SKUNK

wide, and may either completely unite or be separated merely by a narrow dark band, the tail being either pure white or black and white. The range of the white-backed group extends northwards from Patagonia and Chile through Central America to Texas. Subject to modifications engendered by their surroundings, the habits of most species of skunks are very similar.

The lesser skunks alone are good climbers, the other



THE SKUNK

species preferring clearings and open glades rather than dense forests. Skunks may frequently be found in the neighbourhood of human dwellings, although in Patagonia and the Argentine pampas they inhabit perfectly open country. In common with other members of the family, they are largely nocturnal, but may be met with walking abroad in the evenings in North America, while Darwin states that in Patagonia one of the white-backed species, "conscious of its power, roams by day about the open plains, and fears neither dog nor man." This indifference to the presence of other creatures is, indeed, one of the most striking characteristics of the group, and is, as suggested by Darwin, doubtless due to the immunity of attack which these creatures possess, owing to their nauseous secretion.

In the Adirondack region the chief food of the typical skunk consists of mice, salamanders, frogs, and the eggs of birds that nest on or near the ground, while such hens' nests as are met with are sure to be robbed, and an occasional raid is made on the poultry-yard. A large number of beetles, grasshoppers, and other insects is likewise consumed by these animals.

Owing to its fearless and unsuspicious nature, the common North American skunk may be taken in almost any kind of trap; and these animals are often a considerable annoyance to the trapper, owing to their habit of entering the snares set for more valuable quarry. Skunks are slow in movement and deliberate in action, and do not often hurry themselves; their ordinary gait being a measured walk, although when pressed for time they break into a slow, shuffling gallop. It is hard to intimidate a skunk, but when once really frightened it gets over the ground at a very fair pace.

In the Adirondack region skunks remain active during the greater part of the year, and hibernate only during the severest part of the winter. In the more southern districts of North America they doubtless remain active throughout the year, and this is probably true

of those inhabiting Central and South America. The nests of skunks are formed either in holes in the ground, in hollow trunks of trees, or among rocks; and in the North American species the number in a litter is usually from six to ten. The young are born in the spring and remain with their parents till the following spring, when they have to make way for a fresh family; and if a trap be set at the entrance of one of these holes the whole family may commonly be captured, at the rate

of one per night. Surprising as it may appear, the typical skunk, especially when captured young, is said to make a pretty and agreeable pet, gentle in manners and cleanly in habits; while the beauty of its fur makes it appear highly attractive.

Stranger still, the flesh of these animals is reported to be white, delicate, and highly palatable.

The secretion that has given the skunk such

an ill-name is contained in a pair of glands

situated beneath the tail, and can be ejected at the will of the animal; such ejection taking place only when the creature is attacked or irritated. So forcibly can the fluid, which is of an amber colour, be ejected that it will carry a distance of from 13 to a little over 16 feet.

Of the lasting and pernicious effects of even a drop of skunk secretion, no more striking instance exists than one recorded by Mr. W. H. Hudson, who writes of a South American species. This observer relates, as a not uncommon event on the Argentine pampas, that a settler starts one evening to ride to a dance at a neighbour's house. "It is a dark, windy evening, but there is a convenient bridle-path through the dense thicket of giant thistles, and striking it he puts his horse into a swinging gallop. Unhappily the path is already occupied by a skunk, invisible in the darkness, that, in obedience to the promptings of its insane instinct, refuses to get out of it, until the flying hoofs hit it and send it, like a well-kicked football, into the thistles. But the fore feet of the horse, up as high as his knees, perhaps, have been sprinkled, and the rider, after coming out into the open, dismounts and walks away twenty yards from his animal, and literally smells himself all over, and with a feeling of profound relief pronounces himself clean. Not the minutest drop of the diabolical spray has touched his dancing-shoes."

"Springing into the saddle, he proceeds to his journey's end, and is warmly welcomed by his host. In a little while people begin exchanging whispers and significant glances; ladies cough and put their handkerchiefs to their noses, and presently begin to feel faint and retire from the room. Our hero begins to notice that there is something wrong, and presently discovers its cause; he, unhappily, has been the last person to remark that familiar but most abominable odour, rising like a deadly exhalation from the floor, conquering all other odours, and every moment becoming more powerful. A drop has touched his shoe after all."

Fossil remains of skunks belonging to the same genus as the species still inhabiting the country are met with in the caverns of Lagoa Santa, in Brazil, where they are accompanied by those of a number of other animals of totally extinct types. This group immigrated into South America after the union of that continent with North America.

ZORILLES

The South African animal commonly known as the Cape polecat, or zorille (*Ictonyx*, or *Zorilla*, *striata*), is so like a small skunk in colouring and appearance that it might well be taken for a member of the same group. Although the number of teeth is the same as in the skunks, the teeth themselves are relatively smaller, with short cusps, and are thus more like those of the polecat, between which and the skunks the Cape polecat appears to form a kind of connecting link. The skull may be distinguished from that of a skunk by the upper molar tooth being smaller, instead of larger, than the flesh tooth.

In size the Cape polecat agrees approximately with an ordinary polecat, and has a somewhat similarly shaped body and proportionately short limbs. The head is broad, and the muzzle long and sharp, while the ears are very small and rounded. The tail is comparatively long and bushy, and about three-quarters of the length of the head and body, and the whole of the fur is relatively long and thick. The ground-colour of the fur is glossy black, marked with a variable number of white stripes and spots. The face is marked by three white patches—one central and two lateral. The hind part of the head is frequently white, and from this white area are given off pure white stripes separated by three narrow black ones, which may unite near the tail; the upper part of the latter being also mostly white. In other cases, however, the whole of the hind part of the head, the neck, and the anterior portion of the back are white.

Senegal is the home of a closely allied species (*I. senegalensis*); a third kind, *I. erythraea*, distinguished by the three white face patches being united, inhabits the Suakin district; while a fourth species, *I. libyca*, from Northern Africa, has a broad white band right across the forehead, and is also differently coloured on the body. This last-named species also ranges into Asia Minor, where it has been taken in the neighbourhood of Erzerum. A fifth kind, *I. frenata*, is restricted to Southern Kordofan.

These animals frequent rocky districts, hiding either in the clefts of rocks or among bushes and trees, and are purely nocturnal. They feed on mice and other small mammals, birds and their eggs, and lizards and frogs; and in inhabited districts often destroy poultry. In their general habits they are unlike martens and polecats, being unable to climb, and only taking to the water under compulsion, although, when necessity arises, they can swim well. Their great protection against their foes is their intolerable odour, which is described as being almost, if not quite, as offensive as

that of the skunks. In many houses of the Boers of South Africa tame individuals of the Cape polecat may be found, which are kept for the purpose of catching rats and mice, their Boer name being *muishund*, signifying "mouse-dog." Possibly the striped weasel (*Pecilogale*), mentioned on page 512, should be placed next the zorilles.

FERRET-BADGERS

The ferret-badgers of South-Eastern Asia form a small group of several species, which in some respects serve to connect the preceding animals with the true badgers, having relatively longer bodies, shorter limbs, and longer tails than the latter. They are all of comparatively small size, and distinguished from the other members of the badger-like group by having the under surface of the body lighter-coloured than the back; while one species is remarkable for the brilliant orange tint of certain parts.

All these animals have the same number of teeth as the martens, but the upper molar and flesh tooth are remarkable for their broad and squared crowns. The head is elongated, and terminates in a prolonged and naked muzzle, with obliquely truncated nostrils, and the ears are small but distinct. The claws are very narrow, and about twice as long in the fore as in the hind feet, the soles of the feet being naked. The tail, which is more or less bushy, may be either rather more or rather less than half the length of the head and body.

Of the various species, the brown ferret-badger (*Helictis orientalis*), in which the length of the head and body is 16 inches, and that of the tail, with the hair, 9 inches, inhabits the Nepal Himalaya and Java, and is characterised by its brown or yellowish brown colour and its relatively long tail. The Burmese ferret-badger (*H. personata*), which differs in the greyish tint of the upper parts, inhabits Lower Burma and Manipur, and probably some neighbouring districts. Of the remaining species, two, *H. moschata* and *H. subaurantiaca*, are from China. The latter is characterised by its relatively short tail, and the brilliant orange colour of the snout and the sides and the lower surface of the head and throat; the ears, a stripe down the neck, and the under parts of the feet being yellow. The upper portion of the head and face is chocolate-brown, forming a most marked contrast with the orange, while



CAPE POLECATS

the back and tail are olive-colour. Ferret-badgers are purely nocturnal, and differ from the other members of the present group in being able to climb with facility. The Indian species are almost omnivorous in their food, eating small mammals and birds as well as fruit and insects. All the species live, as a rule, in forests.

AMERICAN BADGER

The American badger (*Taxidea americana*) is the first of four genera which may be collectively called badgers, all of which are confined to the Northern Hemisphere. They all have the same number of teeth as the martens, that is to say, thirty-eight, of which $\frac{3}{4}$ are

BADGERS

incisors, $\frac{1}{2}$ canines, $\frac{4}{4}$ premolars, and $\frac{1}{2}$ molars on each side of the jaws. All have stoutly built bodies, and short limbs adapted for digging; while, with one exception, the tail is very short. They are further characterised by the unusually large size of the molar tooth of the upper jaw, and by the elongation of the posterior heel of the flesh tooth of the lower jaw.

In the American badger the skull is very wide posteriorly, the body depressed, and the tail very short. The skull may be at once distinguished from that of the European badger by the proportionately larger size of the upper flesh tooth and the smaller upper molar, which is triangular in form, with the apex directed outwards. The fore claws are enormous, the eyes are very small, and the muzzle is hairy right up to the obliquely truncated nostrils. The low, rounded, and broad ears are remarkable for the size of their apertures.

In length this animal, from the snout to the root of the tail, measures about 24 inches, and the tail 6 inches. The general colour of the coarse fur of the body is a blackish grizzle, mingled with white, grey, or tawny, or the whole of these together, on the upper parts, while below it is uniformly whitish, sometimes shaded with grey or tawny. The head is darker than the body, with a white stripe down the middle, and the limbs are blackish brown.

The ordinary type of the American badger extends from British North America, from at least latitude 58°, over the greater portion of the United States. Near the Mexican border of the States, as in Eastern and Central Mexico itself, it is, however, replaced by a variety distinguished by a white stripe, sometimes interrupted, running down the back from the nose to the tail.

In habits the American badger closely resembles the common European species, being strictly nocturnal and living in burrows constructed by itself. In the colder portion of its habitat it hibernates. Although very seldom seen, these animals live in countless numbers in the region of the Upper Missouri and its tributaries, tracts of sandy soil being so full of their burrows as to render travelling on horseback dangerous. The abundance of the American badger is due to its immunity from foes and the plentiful supply of food.

In addition to the various species of rodents which form its principal food, the American badger will also eat smaller animals—even insects and snails—while it is also partial to birds' eggs, and to bees' nests with their honey and larvæ. It is shy and retiring, seeking to avoid rather than court danger. If brought to bay, it will fight with all the fierceness and stubbornness of its European cousin, and exhibits similar tenacity of life. In some parts of the Western States badger-baiting used to be a favourite sport, but it is now discontinued.

Very little has been ascertained as to the breeding habits of the American badger, but it seems that three or four is the usual number in a litter. In British

North America the period of hibernation lasts from October till April, and the animals are said to come forth after their long fast in good condition.

American badger fur is of some value, and is at times largely used for robes, muffs, tippets, and trimmings; while a considerable quantity of the long hairs are employed in the manufacture of shaving and other brushes, although in many cases the hairs are too soft.

TYPICAL BADGERS

The typical, or European, badger (*Meles taxus*) is the best-known member of a group of several closely allied species distributed over a considerable portion of

Europe and Asia, although unknown in the Indo-Malay region. All are distinguished from the American badger by the characters of the skull and teeth. The skull itself is characterised by the great height of the bony ridge running along the middle of the brain case, and affording attachment for the powerful muscles which render the badger's bite so severe. Then, again, the upper molar tooth, instead of being triangular and of nearly the same size as the flesh tooth, is oblong in form, and

much larger than the latter, recalling in this respect the corresponding tooth of the bears; a further analogy with that group being presented by the small size of the first three premolar teeth.

Another feature in which the typical badgers differ from the American badger is in the great development of the posterior heel of the lower flesh tooth, which exceeds in length the whole of the remainder of the tooth, this expanded heel having to bite against the enlarged upper molar tooth. The skull of the badger is also peculiar on account of the close interlocking of the lower jaw with the skull proper, the articulation being so perfect that it is impracticable to detach the one from the other without fracture.

In general bodily conformation the Old World badgers very closely resemble their transatlantic relative, and their hairs are similarly banded with different colours, producing the well-known grizzled hue of the fur so characteristic of all these animals. The skin of the European badger is remarkably large and loose, enabling the animal, when seized by almost any part, to turn and bite its aggressor; and the fur is long and loose. With the exception of a black stripe on each side, starting between the nose and the eye and running backwards to include the ear, of which the tip is white, the head of the badger is white. The lower jaw, throat, and all the under parts, as well as the limbs, are black; while the upper parts are reddish grey, and the flanks and tail light grey. The length of a full-grown badger from the snout to the root of the tail will vary from about 25 to 29 inches, that of the tail being about $7\frac{1}{2}$ inches; and the weight has been estimated at from 25 to 30 lb.

The badger, or, as it used to be called in England, the brock, is distributed over the whole of Europe, with the exception of the north of Scandinavia and the island of Sardinia; and it is also widely spread



THE AMERICAN BADGER

over Northern Asia, where it ranges in Siberia as far as the River Lena. It is probably also this species which inhabits Syria; but it is at present uncertain where the range of the common badger in Western Asia terminates, and where that of the smaller and paler-coloured Persian badger (*M. canescens*) of Eastern Persia begins. In China and other parts of continental Asia the group is represented by the white-tailed badger (*M. leucurus*) and the Chinese badger (*M. chinensis*), while another species (*M. anacuma*) inhabits Japan.

On the Continent, especially in many parts of Germany, where it is known as *dachs*, the badger is very common, and does much damage to the vineyards. In the British Islands, as may be judged both from the frequency with which its remains are met with in the cavern and other superficial deposits, as well as from the number of places in England, such as Brockenhurst, Brockley, and Brockwell Park in London, which derive their names from this animal, the badger must once have been very commonly distributed, and, indeed, it is still by no means rare.

The favourite haunts of the badger are the deepest and thickest woods, or coppice-clad cliffs and quarries; and in such situations it digs a large and roomy burrow. Here it sleeps during the day, issuing forth at evening in search of food, and sometimes joining with its fellows in this quest. In the colder portions of its habitat the badger hibernates during the winter, the length of the hibernation depending upon the latitude and the degree of severity of the season. In England the hibernation appears to be always interrupted. The peculiar conformation of the upper molar teeth of the badger proclaims that the diet of the animal is by no means exclusively carnivorous, and its ordinary food comprises roots, pig-nuts, beech-mast, fruits, the eggs of birds, various small mammals, frogs, and insects. Badgers are also in the habit of digging up wasps' nests for the purpose of feeding upon the larvæ in the combs, and they have an equal partiality for the contents of the nests of wild bees.

Badgers will likewise eat various kinds of fungus, and in Finland it has been observed that they will dig out truffles. It is stated, for instance, that over an area of about a couple of acres in a certain part of Finland patches of ground containing truffles were found to have been dug up by some animals, and the funguses eaten. The shape of the footprints and the nature of the droppings clearly proved that the workers were badgers. The soil in which the truffles grew was dark-coloured moist earth, mingled with patches of greyish sand.

It has been very generally asserted that badgers and foxes do not get on well together, and that the former kill the cubs of the latter. Mr. Ellis, however, stated that on his Loughborough estate, at least, "the badgers and the foxes are not unfriendly, and one spring a litter of cubs was brought forth very near the badgers; but their mother removed them after they had grown familiar, as she probably thought they were showing themselves more than was prudent." Mr. Harting has also mentioned more than one instance where these

two animals have lived amicably together in the same burrow; in one of these cases a fox having annually given birth to cubs in the badger's den.

Within the deep recesses of its burrow, which often terminates in a fork-like manner, are born the young of the badger; the number in a litter being three or four. The young are produced during the summer, and are at first blind, not acquiring the power of sight till the tenth day. It is a curious, but apparently well-ascertained, circumstance that the female badger, like the roe-deer, has the power of extending the time of gestation considerably beyond the usual period.

On this subject Mr. A. H. Cocks has arrived at what he confesses to be the very remarkable conclusion "that the pairing may take place at any time during a range of some ten months, and yet that the young are always born within a season limited to about six weeks. In other words, it appears that the gestation may amount to anything between under five and over fifteen months, and yet that the young are all born within some six weeks of each other; and, moreover, that the females which paired earliest by no means necessarily whelp earlier during the six weeks' season than others which paired several months after them."

The difficulty of "drawing a badger" when in a tub is well known, and tries the pluck of the best-bred

terriers to the utmost. It appears, however, that in Germany *dachshunds* usually bolt the badger from its burrow, unless they are foiled by the creature digging deeper down and burying itself beneath the upturned soil. Other methods employed in Germany are either digging the animal out by following the course of the burrow, or boring directly down upon it by means of a kind of gigantic corkscrew. Digging out is also sometimes re-



THE BADGER

sorted to in England, but the more common plan is to tie an empty sack, with a running noose round its mouth, in the entrance of the badger's burrow while the occupant is abroad, and then drive him in with dogs. A memory of badger-baiting, once common in England, survives in the phrase "to badger."

The fur and hairs of the badger are used for the same purposes as those of its American cousin; but the hairs, being stiffer, are better adapted for brushes.

Fossil remains of the badger are met with in the cavern and other superficial deposits of England, and also occur in those of the Continent. Beyond these, however, no fossil badgers have hitherto been met with, except in strata of the Pliocene period in Persia. When our comparatively full acquaintance with the extinct Tertiary mammals of Europe and Northern India is taken into account, this remarkable absence of the remains of badgers is suggestive that Persia or the adjacent regions were the original ancestral home of these animals, whence they migrated westwards.

TELEDU, OR MALAY BADGER

The sole representative of the badgers inhabiting the islands of the Malay region is the Malay badger (*Mydaus meliceps*), known to the natives of Java as the *teledu*, and to Germans, on account of its evil odour as *stinkdachs*.

SAND BADGERS

The Malay badger appears to form a kind of connecting link between the true badgers and the sand badgers, having a tail shorter than in the former, while its cheek teeth are much more like those of the latter. It is a comparatively small animal, the length of the head and body being about 15 inches, and that of the stumpy tail



BADGER CUBS AT PLAY

only some $\frac{3}{4}$ of an inch. With the exception of the back of the head, the top of the neck, a stripe down the back, and the tip of the tail, which are whitish, the general colour of the long and thick fur is dark brown, lighter below than above.

There is a kind of crest of long hair on the back of the head and neck; and the muzzle is long and pointed, and almost entirely naked in front of the eyes, with the flesh-coloured nostrils obliquely truncated and mobile. The teledu appears to be confined to the mountains of Java, Sumatra, and Borneo, ranging in the former island from an elevation of about five hundred to upwards of seven thousand feet above the level of the sea. In Borneo it is found at elevations of not more than eighty or one hundred feet, and in Sumatra it does not ascend above one thousand feet. It is a nocturnal and burrowing animal, not uncommon in some districts.

When killed carefully, the scent-glands being immediately removed, the flesh of the Malay badger is free from odour, and far from unpalatable. The secretion of the glands, however, is fetid in the extreme, and has been compared to that of the skunks; and, as in the latter, it can be ejected by the animal to a considerable distance. It is interesting to note in connection with this strong odour the light stripe on the back of the animal, which renders it a most conspicuous object. There seems to be little information as to the habits of this animal in a wild state, but it is stated to be gentle, and easily tamed when in captivity.

SAND BADGERS

The sand badger, or, as it is often termed, the hog-badger (*Arctonyx collaris*), the last representative of the badgers, is an Indian species, ranging from the

Eastern Himalaya through Assam and the neighbouring regions to Tenasserim and Lower Burma; but there is also a smaller species (*A. taxoides*), inhabiting Assam and Arakan, and possibly China, while there is probably a third in North-Eastern China.

Sand badgers are easily distinguished from the other members of the group by their proportionately longer tails, that of the Indian species being from a quarter to a third the length of the head and body. The long and naked snout is very like that of the Malay badger; the eyes are minute, and the ears likewise small and rounded. The body is rather flattened from side to side, and only a portion of the naked soles of the feet is applied to the ground in walking, so that these animals may be described as digitigrade rather than plantigrade when in motion. The coat consists of a full, soft under fur, mingled with long, stiff hairs.

In colour the Indian sand badger is dirty grey both above and below, with a more or less marked blackish tinge on the back, most of the hairs being dirty white throughout their length, but the longer ones on the back and sides having black tips. The head is white, with some variable black bands, but the lower parts and limbs are dusky, the limbs being sometimes black; so that we have another instance of the tendency in the present family for the under parts to be lighter than the upper surface. In length the Indian sand badger measures about 30 inches from the snout to the root of the tail; the length of the latter, inclusive of the hair at the tip, being about 11 inches.

The most marked peculiarities of these animals are to be found in the structure of the skull, which differs from that of any other mammal, except certain edentates and dolphins, in having the bony palate prolonged as far back as the level of the cavity for the reception of the condyle of the lower jaw. The teeth are numerically the same as in the true badgers, but the upper molar tooth, instead of forming a regular oblong, has its hind outer angle excavated, so that the inner border of the tooth is much longer than the outer



THE MALAY BADGER

one. The first premolar tooth in the upper jaw is very minute, and often soon shed.

The Indian sand badger frequents undulating stony ground or small hills among jungle, where it lives in fissures of the rocks or holes dug by itself. It is thoroughly nocturnal. In captivity it is dull and

uninteresting, feeding voraciously on meat, fish, reptiles, or fruits, and being particularly fond of earthworms. One used to pass the day sleeping in a hole it had dug, and was very savage if disturbed; when angry, it made a loud grunting noise and bit fiercely. Dull of sight, its only acute sense appeared to be that of smell; and it was in the habit of raising its snout in the air in order to scent anyone who approached, much as a pig does. This animal had no disagreeable smell.

OTTERS

The otters, which, with the sole exception of the sea-otter, are usually included in a single genus (*Lutra*), constitute the third and last main group into which the members of the weasel family are divided; and are characterised by short and rounded feet—although the hind feet of the sea-otter are an exception in this respect—webbed toes, and small, curved, and blunt claws. They have very broad and flattened heads, furnished with small external ears, and joined to the long, flattened body by a thick neck, which passes imperceptibly from the head in front into the trunk behind. The tail is moderately long, while the limbs are extremely short. The fur is soft, thick, and of a uniformly brownish colour over the whole body, except on the under parts, where it is generally of a more greyish hue. The teeth of otters are characterised by the nearly square form of the molar in the upper jaw, which has its inner portion much expanded. All otters are thoroughly aquatic in their habits.

The typical otters, which include all the species except the sea-otter, are characterised by their hind feet being of normal form, and by the number and structure of their teeth. As a rule, the total number of teeth is thirty-six, of which, on each side of the jaws, $\frac{3}{4}$ are incisors, $\frac{1}{4}$ canines, $\frac{1}{4}$ premolars, and $\frac{1}{4}$ molars. The first premolar tooth in the upper jaw, however, is always very small, and in some species may be totally wanting, thus reducing the number of the teeth to thirty-four.

In addition to the peculiar characters of the teeth, the skull of an otter may always be recognised by its extreme constriction immediately behind the sockets of the eyes, and the equally marked expansion of the flattened brain case; the portion of the skull forming the face being also very short in proportion to the remainder. The tail is thick at the base, and somewhat flattened from above downwards. In most cases there are short claws on all the feet, but in a few species these may be rudimentary or absent.

In all parts of their organisation otters are admirably adapted for their particular mode of life; their elongated bodily form, with but slight constriction at the neck, being admirably suited to enable them to glide through the water with the greatest ease and speed; their thick, dense fur forming a perfect protection against chill; and their cheek teeth being specially modified in order both to hold such slippery prey as fishes, and at the same time to pierce with facility their hard scales. Probably in consequence of

their precisely similar habits and mode of life, many otters are so like one another that it is difficult to determine the exact number of species, and scarcely any group has proved more puzzling in this respect to the systematic naturalist. The largest of all is the Brazilian otter, while the two smallest species are the Chilean otter and the Indian clawless otter. The geographical distribution of the group is as extensive as that of cats and dogs, otters occurring in all parts of the world except the Antarctic and Arctic regions, Australasia, and Madagascar.

THE EUROPEAN OTTER

The European otter (*L. vulgaris*), so far as size is concerned, occupies a kind of central position in the group, the average length from the snout to the root of the tail being about 26 to 28 inches, and that of the tail 15 to 16 inches, while the weight is from 16 to 18 up to as much as 20 lb. (page 25). The fur consists of a soft under fur, in which the hairs are whitish grey, with brown tips, and of longer stiff hairs, which are greyish at the base, and rich brown at their tips on the upper part of the body and the outer surfaces of the limbs; the cheeks, throat, the under side of the body, and the inner surfaces of the limbs being brownish grey.

The upper margin of the naked nose terminates behind in an angle, while, as in the other species, the muzzle is provided with long "whiskers." In the Indian race, formerly regarded as a distinct species, the fur of the back is grizzled, while the size of the animal is slightly less than in the ordinary European otter. The claws on all the feet are well developed, and there are four premolar teeth in the upper jaw.

The otter is found all over Europe in suitable localities, and also extends over a large portion of Asia northwards of the Himalaya. It is likewise represented in

the North-Western Himalaya, India, and Ceylon, while it also extends to Burma, China, Japan, and Northern Africa.

Writing of the habits of the otter, Professor Thomas Bell observes that "it swims and dives with great readiness, and with peculiar ease and elegance of movements; and although its action on land is far from being awkward and difficult, yet it is certainly in the water that the beautiful adaptation of its structure to its habits is most strikingly exhibited. It swims in nearly a horizontal position, and dives instantaneously after the fish that may glide beneath it, or pursues it under water, changing its course as the fish darts in various directions to escape from it, and, when the prey is secured, brings it on shore to its retreat to feed." The fish actually eaten by the otter, however, form only a small proportion of those captured; this animal being one of those which appears to delight in killing for killing's sake. In India this otter is occasionally found in the large tanks so common throughout the country, and is stated to be common in the great backwaters off the western coast, and in the Chilka Lake of Orissa.



OTTERS IN THE LONDON ZOOLOGICAL GARDENS



THE COMMON PORCUPINE

"The common porcupine is characterised by its massive form, its large size, the great length of the quills on the body, and by the short, spiny tail terminating in a cluster of short, slender-stalked quills."



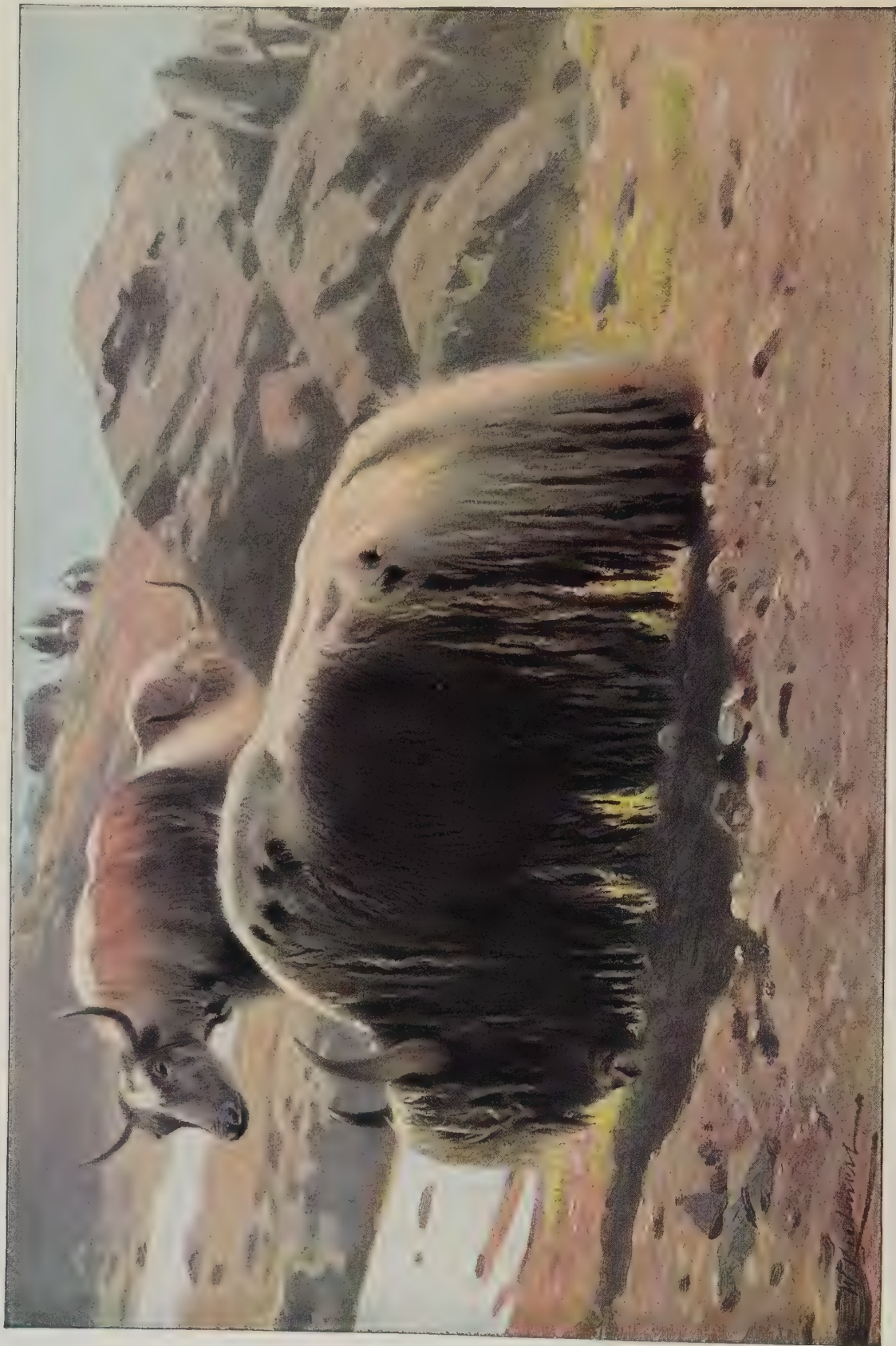
THE BEAVER

"In America, beavers generally select as their haunt a well-timbered district traversed by a narrow stream."



HARVEST MICE

"The harvest mouse was first discovered in England by Gilbert White, of Selborne, and is so small that its weight is only about one-sixth of an ounce."



DOMESTICATED YAK

...Domesticated yak are kept by the inhabitants of the higher regions of Tibet as beasts of burden, and for the sake of their flesh, and are absolutely essential for crossing many parts of that desolate region.

THE EUROPEAN OTTER

Otters are generally found either in pairs or in family parties of four or five, the latter comprising the parents and their partially or full-grown progeny. Their habitations are usually made in or near the banks of the waters they frequent, the hollows beneath the roots of trees growing on a river's margin being especial favourites, while in hilly districts the clefts between rocks are selected, and where the soil is of an alluvial nature deep burrows, with several entrances, one of which opens beneath the water, are excavated in the banks.

A large pile of loose stones, forming one of the piers of a timber bridge over the Indus above the town of Leh, has long been the favourite resort of a colony of otters. The presence of numerous bones and scales of fishes, as well as the peculiar web-footed tracks of the animals themselves, will always indicate whether or not an otter's den or "holt" is inhabited.

Otters apparently never hibernate, and in consequence are often hard pressed to supply themselves with food during the winter in the colder portions of their habitat. At such times in inhabited districts they make occasional raids on the farmyard, where they have been known to kill poultry and, it is said, even young lambs and pigs. Water-fowl are probably also attacked at such periods, while it is stated that eggs are always acceptable to these animals. In addition to fishes, otters are in the habit of eating frogs and freshwater marine crustaceans.

Although chiefly nocturnal—more especially in districts where they are much harassed—otters may be seen hunting in the morning and evening, and in India they may be noticed at work up to 9 or 10 a.m. When fishing, the members of a party of otters are in the habit of combining to surround or drive a shoal of fish.

The large size of the aperture in the skull below the socket of the eye for the transmission of the nerves supplying the muzzle indicates that the "whiskers" of the otter must be extremely sensitive. With regard to their powers of hearing, smell, and sight, it is probable that, while the two former are well developed, otters are somewhat deficient in the last. Their intelligence is high, and they often display much cunning and forethought, more especially in avoiding the traps set for their capture. When excited, they utter a kind of yelping bark, and are stated to give a sort of whistle as an alarm-note to their fellows. It appears that the young may be produced at any season of the year, although the winter is the more usual time. The number of young in a litter varies from two to five, the cubs themselves being born blind.

Otters are readily tamed if captured at a sufficiently early age, and then become much attached to their owners, whom they will follow about after the manner of a dog. The natural instincts of these animals are taken advantage of by the native fishermen of some Oriental countries to aid them in their avocations.

Otter fur, from its close texture, fine gloss, and rich colour, is much esteemed as a trimming, and commands a rather high price in the market. A large number of the otter skins imported into Great Britain belong to the North American species. Skins of the European species vary from five to thirty shillings in price.

Fossil remains of the otter have been obtained from the superficial deposits and caverns of England and the Continent, and likewise from the so-called Forest-Bed of the Eastern Coast, which is somewhat older. A fossil otter from the still more ancient Norwich Crag, belonging to the upper portion of the Pliocene period, has been identified with the living species.

THE NORTH AMERICAN OTTER

The North American otter (*L. canadensis*) is distinguished by the much larger size of the naked area at the tip of the muzzle, which extends far above and to the sides of the nostrils, instead of being confined to the space between them. It is very variable in point of size and colour, and may attain a total length of four feet or more: the general colour of the fur is liver-brown with a purplish gloss, the chin, throat, and under parts being paler. This species occurs over the whole of North America in suitable regions, although apparently nowhere very numerous, its northern range extending along the Mackenzie and other rivers nearly to the Arctic Ocean.

There does not appear much that is especially noteworthy or peculiar in the habits of this species. Dr. C. H. Merriam states that in the Adirondack region the number of freshwater cray-fish consumed by these otters is enormous, these crustaceans apparently forming as important a portion of their food as fishes do. The same writer also bears testimony to the long journeys undertaken by the North American otter from river to river across country; these journeys mostly taking place during the winter. On such occasions they "go so fast that a man has great difficulty in overtaking them. On the ice they proceed by a series of what boys call 'a run and a slide'; that is, they make several jumps, and then slide ahead flat on their bellies, as far as their impetus and the smoothness of the ice permit, and then do the same thing over again, and so on."

The number of young in a litter is said to be usually two, although there may occasionally be either one or three. They are born about the middle of April, and during the summer and autumn the female is generally to be seen accompanied by her young. The fur of the otter is in good condition from November till the spring, but is at its best period during the latter season.

THE BRAZILIAN OTTER

South America possesses several species of otters, among which the Brazilian otter (*L. brasiliensis*) is the largest of all the living species, and distinguished by the presence of a distinct ridge running along each side of the tail, whence it is sometimes termed the margin-tailed otter. It inhabits the rivers of Brazil and Guiana, where it is known as the ariranha. The total length may be as much as 6 feet. The nose is completely covered with hair, and the general colour of the coat chocolate-brown, becoming lighter on the under parts; the chin, as well as a large irregular patch on the throat, and some spots on the under surface of the body, being whitish or yellow.

In some of the South American rivers these otters may be met with in large companies, and they differ from most other species in being purely diurnal,



HEAD AND FORE QUARTERS OF OTTER

beginning their hunting with dawn and continuing till nightfall. When in such companies, the otters utter a kind of whistling sound, said to have some resemblance to the mewing of cats. Hensel states that, when on the Brazilian rivers in a canoe, the traveller's ears are struck by a peculiar snorting sound, and as he looks around he sees the water on all sides dotted with the dark heads of the giant otters, which, with a second snort, disappear again as quick as lightning beneath the surface. Sometimes these great otters may be seen reposing on the huge flat leaves of the giant water-lily (*Victoria regia*).

THE CHILIAN OTTER

In marked contrast to the preceding, the Chilean otter (*L. felina*) is one of the smallest members of the group, agreeing approximately in size with the Indian clawless otter. It is characterised by its relatively

the upper border of the naked portion of the muzzle forming a straight line, while the fur is very smooth and short.

The skull is also less depressed and flattened, and the molar and flesh teeth in the upper jaw are very large, the latter differing from the corresponding tooth of the common species by the larger proportionate size of the tubercular portion on the inner side of the blade. This otter is found all over India, and also extends to Burma, the Malay Peninsula, and Sumatra. Its habits appear to be very similar to those of the European otter, and, like the latter, it is trained for fishing.

THE HAIRY-NOSED OTTER

The hairy-nosed otter (*L. sumatrana*) is a very well-marked species from the Malay region distinguished, as its name implies, by the muzzle being completely covered with hair; and also by the inner tubercle of

the upper flesh-tooth being relatively small. A closely-allied extinct species (*L. palæindica*) occurs in the Siwalik Hills of Northern India, in strata belonging to the Pliocene division of the Tertiary period.

Another living Oriental species is *Lutra barang*, which is a smaller and greyer animal than the European otter, ranging from India to Burma, the Malay Peninsula, and Sumatra; but apparently



AN OTTER SWIMMING

short face and light and delicate teeth, the inner tubercle of the upper flesh tooth being much smaller than in the other species from the same region. This species also differs from other otters in being almost exclusively marine in its habits. Its distribution extends from the Strait of Magellan northwards to the coasts of Patagonia and Chile, where it is exceedingly common, the complex labyrinths of gulfs and channels being highly favourable to its manner of life; and it has also been found in Peru and Ecuador.

In regard to the naked-nosed and flat-headed South American otters intermediate in size between the two last species, there is still some uncertainty, but they are all provisionally included under the name of *L. paranensis*.

THE SMOOTH INDIAN OTTER

In addition to the European otter, there are other Indian and Malay representatives of the group, the first of these being the smooth Indian otter (*L. macrodus*), readily distinguished from the common otter by

has much the same general habits, and feeds entirely on fish. It has well-developed claws.

THE INDIAN CLAWLESS OTTER

A distinct subgeneric group is typified by the small Indian clawless otter (*L. [Aonyx] cinerea*), which differs from other species of the same region not only in its inferior dimensions, but also in the rudimentary condition, or even total absence, of the claws. The upper teeth are distinguished by the absence of the first premolar, and the great length from front to back of the molar tooth; while the whole skull is much shorter than in the other Indian species. The length of the head and body varies from 22 to 24 inches, and that of the tail from 10½ to 13 inches.

The clawless otter ranges from India through Burma and the Malay Peninsula and islands to China. In India it occurs in the Himalaya at low elevations, in Lower Bengal and the Nilgiri Hills of Madras, and perhaps also in Ceylon. It appears to be the only otter found in Java. Its habits are stated to be generally similar to those of the other Indian species.

EXTINCT OTTERS

THE AFRICAN CLAWLESS OTTER

Africa is the home of two species, of which the African clawless otter (*L. [Aonyx] capensis*), ranging from South and West Africa to Abyssinia, agrees with the Indian clawless otter in the rudimentary condition of its claws, but is distinguished by its greatly superior dimensions, being, next to the Brazilian otter, the largest representative of the whole group. Writing of this species, which he alludes to under another Latin name, Professor H. N. Moseley states that "it lives about the salt marshes and lakes, and is tolerably common; it hunts, like the South American marine otter, in companies of three or four. It has no claws on the fore feet, having lost them by natural selection in some way or other, and on the hind feet the claws are wanting on the outer toes, and only rudiments of them remain on the middle ones. There are, however, pits marking the places where the claws used to exist. The webbing between the toes is also rudimentary; the beast altogether is very heavily built, with the head very broad and powerful. It appears to be an otter bent on returning to land habits."

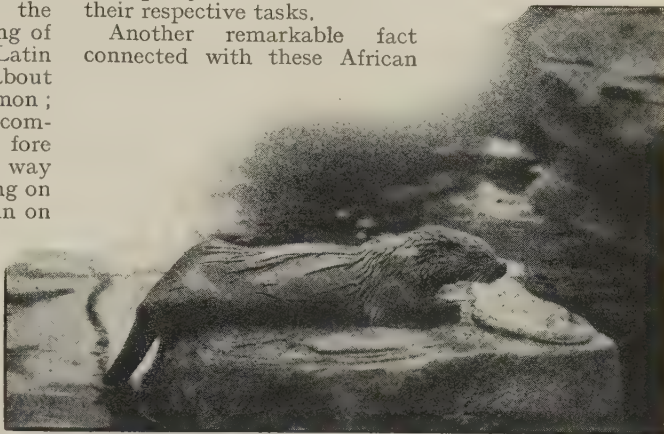
This opinion has been confirmed by Professor E. Lönnberg, who states that the Rhodesian race (*L. capensis hinderi*) is much less aquatic than the spot-necked otter (*L. maculicollis*) inhabiting the same districts. These otters spend much of their time on land, where they make their lairs among grass or reeds, in some instances at a considerable distance from water. They also swim with less agility than the clawed species, not being able to remain submerged for more than one or two minutes at a time. When hotly pursued, they always leave the water to take refuge in covert on shore, where they are not uncommonly put up by the dogs of the sportsman.

In place of fish, their food consists largely of crabs, although they also eat river mussels, and the eggs of ducks and other water birds, as well as ducklings. Native report states that they also devour fishes in the dry season, when the prey is penned up in small pools, but that they are too clumsy to fish successfully in open water.

Both in the Rhodesian race and in the typical South Africa clawless otter (*L. capensis typica*) the cheek teeth have blunter cusps than in ordinary otters, and Dr. Lönnberg suggests that the Cape race,

better adapted for crushing shells than are those of the Cape species, but the latter makes up for this by its more powerful jaws. And as the sea-otter feeds mainly on sea-urchins, which are less hard to crush than bivalve shells, the two species may really be equally well endowed for their respective tasks.

Another remarkable fact connected with these African



AN OTTER JUST OUT OF THE WATER

clawless otters is that the Rhodesian small-headed race has a big-headed representative both to the north and to the south, the Abyssinian *L. c. meneliki* having a skull fully as large and strong as that of the typical Cape animal. The Abyssinian otter inhabits Lake Tzana at an elevation of 4,000 feet above sea-level, but nothing is known with regard to its food or general habits. Its upper molar teeth have, however, extraordinarily broad and blunt-cusped crowns, highly suggestive of a hard-shelled type of food.

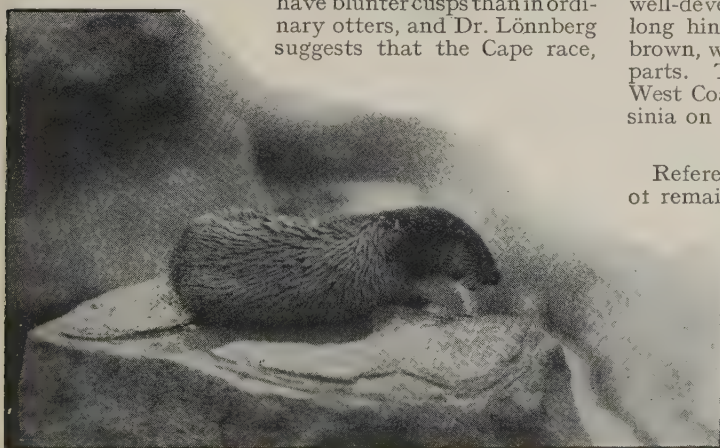
The crab-eating habits of the Rhodesian clawless otter render it easy to understand why this species frequents the same waters as the spot-necked otter, the two kinds not entering into competition with one another. It would be interesting to ascertain whether the Indian clawless otter presents any approximation to its African relative in the matter of food and general habits.

The aforesaid spot-necked African otter (*L. maculicollis*) is one of the smaller members of the group with well-developed claws. It has a naked nose, and very long hind feet, and the colour of the fur is blackish brown, with yellow spots on the throat, chest, and under parts. This otter ranges from the Cape and Natal to the West Coast on one side, and to East Africa and Abyssinia on the other.

EXTINCT OTTERS

Reference has already been made to the occurrence of remains of the ordinary otter in the superficial deposits of Europe, and also to those of an extinct species allied to the hairy-nosed otter in the Siwalik Hills of India. In addition to these, there are numerous otters in the Pliocene and Miocene deposits of Europe and North America belonging to the extinct genus *Potamotherium*, distinguished from all other members of the present family by having two molar teeth on each side of the upper jaw, and thus indicating a more generalised type.

Especial interest attaches to certain giant otters from the Pliocene of the Siwalik Hills of India and the Miocene of Italy, which were even larger than the existing Brazilian otter, and have been referred to a genus by themselves, under the name of *Enhydriodon*.



AN OTTER DRYING ITS COAT

which has a larger and more powerful skull than its Rhodesian relative, subsists mainly on molluscs.

The Cape clawless otter presents, indeed, a certain approximation in skull and dental characters to the sea-otter. It is true that the teeth of the sea-otter are

SEA-OTTER

As already mentioned, the Chilian otter is in the habit of frequenting the lagoons and bays of its native coasts rather than rivers, and these marine habits are still more characteristic of the animal known as the sea-otter (*Lutra lutris*), which forms a genus by itself.

The sea-otter (p. 25) has a total length of about 4 feet, of which 1 foot, or rather less, is occupied by the tail. In general appearance it has been compared to a sea-bear, or eared seal, a resemblance increased by the long and flipper-like hind feet, quite unlike those of all other members of the family to which it belongs. The body has a lobster-like form, tapering in front to join the rather small and rounded head, without any marked constriction at the neck. Both the limbs and tail are short, the latter being cylindrical, slightly tapering, and somewhat truncated at the end; while the disparity in the size of the fore and hind feet is quite unknown in any of the Carnivora hitherto described. The skin is remarkably large and loose for the size of the animal, so that when removed from the body it can readily be stretched to a third more than its normal length. The beautiful coat consists mainly of a fine soft, woolly under fur, among which is a small proportion of long, stiff hairs. The general colour is dark liver brown, silvered over with the greyish tips of the long hairs.

Remarkable, however, as are the external characteristics of the sea-otter, it is not solely or even chiefly on these that naturalists rely in referring the animal to a genus apart from the one containing the true otters. Equally noteworthy peculiarities occur in the number and structure of the teeth. In the first place, there are only two pairs of incisor teeth in the lower jaw—a feature, in which this species differs not only from other otters but likewise from every other true carnivore. The total number of teeth is, therefore, thirty-two, as against thirty-six in the European otter, there being, as in the Indian clawless otter, only three pairs of premolar teeth in both the upper and the lower jaws.

The cheek teeth, although of the same general plan of structure as in the true otters, differ in their extremely blunted and rounded cusps. If, as has been well remarked, the teeth of ordinary carnivorous otters be likened to fresh-chipped, sharp, and angular bits of rock, those of the sea-otter are comparable to water-worn pebbles, and no simile so well expresses the difference between the cheek teeth of the European otter and those of the sea-otter.

The sea-otter is an inhabitant of both coasts of the North Pacific; its chief haunts on the American side being Alaska, the Aleutian Islands, the neighbourhood of Sitka Island on the coast of Southern Alaska, and Vancouver Island, while its southern limits are the shores of Southern California and Mexico. On the

Asiatic side it occurs on the Commander Islands, Kamchatka, and the Kurile Islands.

The female sea-otter has only two teats, and, as a rule, produces only a single young one at a birth, though in rare instances there may be twins, so that the increase of the species can be, at the best, but slow. The young may apparently be born at any season of the year, and do not attain maturity till four or five years old. Writing of the general habits of the species, Mr. H. W. Elliot observes that the "mother sleeps in the water on her back, with her young clasped between her fore paws. The pup cannot live without its mother, though frequent attempts have been made by the natives to raise it, as they often capture it alive, but, like some other species of wild animals, it seems to be so deeply imbued with fear of man that it invariably dies from self-imposed starvation."

The remarkable difference in the structure of the cheek teeth of the sea-otter from those of the true otters clearly indicates that there must be an equally marked difference in the food of the two; and the rounded prominences on the crowns of those of the present species would further suggest that they were adapted for

pounding and crushing hard substances. The food of sea-otters is almost entirely composed of clams, mussels, and sea-urchins, but crabs, the tender fronds of kelp, or seaweed, and fishes are also eaten. Sea-otters are not polygamous, and more than one is seldom seen at a time when out at sea. The flesh is unpalatable, highly charged with a rank smell and flavour.

Sea-otters are playful animals, hunters stating that they have watched them lying on their backs in the water tossing pieces of seaweed up in the air from paw to paw, apparently taking great delight in catching them before

they could fall into the water. They will also play with their cubs for hours. The quick hearing and acute smell possessed by the sea-otter are not equalled by any other creatures. They will take alarm and leave in consequence of a small fire four or five miles to the windward of them, and the footsteps of man must be washed by many tides before its trace ceases to alarm the animal, and prevent it from landing.

Sea-otters obtain their food by diving, and hold it in their paws while devouring it when they come to the surface. In Alaska the sea-otter is often obtained by shooting it in the head with a rifle-bullet when it is sporting in the surf; the booming of the surf deadening the report of the rifle, and thus allowing successive shots to be taken till one is successful.

The skin of the sea-otter is one of the most valuable of all furs, and when prepared for use has all the long hairs removed, leaving only the under fur. In Kamchatka a good skin many years ago would bring as much as a hundred roubles to the native hunter, while a perfect example has been known to realise as much as £200 in the European market.



THE SEA-OTTER

From a drawing of this rare marine quadruped by Wolff. This representation is, however, not quite accurate, in that the tips of the hind toes should be bent under.

EARED SEALS, WALRUS, & TRUE SEALS

THE whole of the Carnivora treated of in the preceding pages constitute the more typical representatives of the order, and are hence collectively termed by naturalists True, or Fissiped, Carnivora. In contrast to these is a much smaller group comprising the eared seals, the walruses, and the true seals, differing from the above by their flipper-like limbs, and hence known as the Pinniped, or Fin-footed, Carnivora. By some naturalists the pinnipeds are regarded as entitled to form an order by themselves, quite distinct from the Carnivora, but by the majority, in England at least, they are considered to constitute merely a suborder.

The members of the pinniped group have their entire organisation adapted to an aquatic life; this adaptation showing itself most markedly in the structure of their limbs. Both fore and hind limbs, for instance, are modified into paddle or flipper-like organs, with nearly the whole of their upper portions, as far as the wrist and ankle, enclosed in the general skin of the body; while the feet themselves are greatly elongated—more especially the hind limb—and much expanded, with all the toes completely connected by webs. A peculiarity of the toes of the hind foot is that the first and the fifth toes—those corresponding to the great and little toes in man—are stouter, and in most cases also longer, than the three middle toes; an arrangement which is unknown among the true Carnivora, where the first toe is the shortest of the series.

The pinnipeds are also characterised by the structure of their teeth, which are simpler than those of the true Carnivora, and never show a specially modified flesh tooth in one jaw biting against a somewhat similarly modified tooth in the opposite jaw. As a general rule, the cheek teeth comprise four pairs of premolars and one pair of molars in each jaw; all these teeth being very similar to one another in general structure, and usually consisting of a pointed main cone, which may be flanked in front and behind by smaller cones, so as to produce a tricuspid tooth. Moreover, the number of incisor teeth is reduced below the typical three pairs in each jaw; there being very frequently three pairs of these teeth in the upper and two in the lower jaw, or sometimes only two pairs in each jaw. Then, again, all the pinnipeds are characterised by the reduced or rudimentary condition of their milk series of teeth, which are never of any real use to their owners, and not infrequently shed before birth.

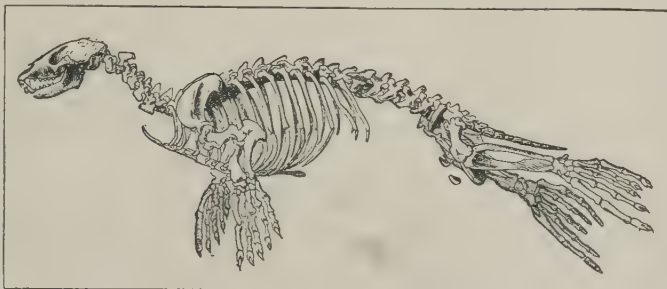
The foregoing characteristics are amply sufficient to distinguish the pinnipeds from the true Carnivora, although they also possess peculiarities in regard to their soft parts, into the consideration of which it is unnecessary to enter. All the members of the group have very short tails, and they are all remarkable for the large size and prominence of their eyes, this being probably necessary in order to secure accurate vision under water. It is noteworthy that in all pinnipeds the rudimentary collar-bones found in most of the true Carnivora have completely disappeared.

There can be no hesitation in regarding the pinnipeds as a highly specialised group which has originated

either from some section or sections of the true Carnivora, or more probably from an extinct group noticed later. In the structure of their skulls the eared seals come nearest to the bears, and it is evident that the whole group must be descended from Carnivora which still retained the typical five digits on each foot.

On the other hand, the true seals present points of resemblance to the otters, and the sea-otter shows how easily the transition from the ordinary otter type to the pinnipeds might have taken place. The sea-otter, however, is clearly, from the structure of its teeth, in no sense a "missing link"; and it is not improbable that the pinnipeds will be found to trace their origin directly to the extinct group of Carnivora to which

allusion has just been made. The pinnipeds have been divided into three distinct families, namely, the eared seals, the walruses, and the true seals. Before proceeding to the consideration of these families, reference may be made to a few characteristics common to the whole group. In the first place, pinnipeds are thoroughly aquatic in their habits, resorting to the land



SKELETON OF THE COMMON SEAL

only for the purpose of repose or breeding, and, when there, moving in an awkward and clumsy fashion. Moreover, they are, as a rule, marine, although some ascend tidal rivers, and a few are found in inland seas and lakes. In the latter instance, however, there is no doubt that access to the ocean has been cut off since the date when the seals first reached the waters in which they are now confined.

All pinnipeds are distinguished by their high degree of intelligence, and are capable of being easily domesticated under favourable conditions. Almost without exception, they subsist on fishes, shellfish, and crabs, lobsters, and prawns, of which they consume enormous quantities. The walruses and eared seals are polygamous, and the males greatly exceed the females in size. The ordinary, or earless, seals are supposed to be monogamous, and there is in most, although not in all, cases comparatively little difference in the size of the sexes. Walruses and eared seals usually resort in large numbers to certain favourite breeding grounds, and during the season of reproduction leave the water, and pass a considerable period upon land. The earless seals, on the other hand, with the exception of the sea-elephants, do not so uniformly resort to particular breeding grounds on land, and leave the water only for very short intervals.

Only one member of the whole group appears to be strictly tropical, and comparatively few even range into tropical regions; the great majority being found in the Arctic, Antarctic, and Temperate zones, many being exclusively Arctic or sub-Arctic, while one is as entirely Antarctic. The walruses are restricted mainly at the present day to the northern regions, but the other two families are well represented on both sides of the equator. Most of the true, or earless, seals are confined to the colder latitudes, and generally produce their young on the ice. A remarkable fact among at least some seals is their power of crying, a faculty unknown in ordinary mammals.

SEA-LIONS AND SEA-BEARS

THE sea-lions and sea-bears (page 25), collectively known to naturalists as eared seals, form a well-marked family, which tends to connect the other and more specialised representatives of the group with ordinary terrestrial Carnivora. In the first place, their hind limbs are decidedly less modified; all the eared seals being characterised by having, when on land, the hind flippers turned forwards under the body in the direction of the head, so that they aid in the support of the trunk in the ordinary manner. They derive their title of eared seals, or *Otariidae*, from the presence of small but well-defined external ears; and by these two characters a sea-lion or a sea-bear may always be distinguished from the other members of the group. They are further characterised by having the soles of both the fore and hind feet entirely devoid of hair.

These seals also have well-marked necks, and their fore feet are nearly as long as the hind ones. In the fore feet the toes decrease in length from the first to the fifth, and have merely rudimentary claws; in the hind feet the three small middle toes have better-developed claws, but the lateral pair is clawless. In both fore and hind feet the skin extends considerably in advance of the tips of the toes, where it terminates in flaps. Usually there are thirty-four teeth, but sometimes, owing to the presence of a second pair of molars in the upper jaw, there may be thirty-six. There are always three pairs of incisor teeth in the upper and two in the lower jaw.

It is some of the sea-bears which alone furnish the "sealskin" of commerce. The sealskin is the under fur, from which the long hairs of the outer coat have been removed; and such species as possess this under fur are consequently termed fur-seals, a term equivalent, in the main, to sea-bears. Those species, on the other hand, which have only the ordinary close coat of hair, without any woolly under fur, are commonly termed hair-seals, most of them being sea-lions, and their commercial value is limited to the oil and leather which they yield.

In regard to the number of species of eared seals, and likewise as to whether they should all be included in a single genus (*Otaria*), or referred to two or more genera, there has been much difference of opinion. Writing in 1880, Dr. J. A. Allen estimated the number of definable species as nine, of which five were hair-seals and four fur-seals. In this work the whole of these are included under the single generic title of *Otaria*, but an alternative plan is to restrict that name to the Patagonian sea-lion, which differs in certain points from all the rest, and to refer the remainder to a second genus (*Arctocephalus*).

This group is widely distributed over the temperate and colder regions of both the Northern and Southern Hemispheres; but, doubtless owing to the lack of suitable sites for breeding places, is unrepresented in

the North Atlantic. As a rule, sea-lions, or hair-seals, and sea-bears, or fur-seals, frequent the same shores, but generally live apart from one another; while, with but rare exceptions, only one species of each section occurs in any one locality. Of the nine species provisionally recognised, two out of the five hair-seals are northern and three are southern; while of the four fur-seals one is northern and three are southern. By other naturalists, however, it is considered that there are certainly two other species of southern eared seals.

All the sea-lions and sea-bears spend a good deal of their time on land, where they assemble in large companies; and they are also polygamous. At the breeding places, known among sealers by the very inappropriate name of "rookeries," the older males are always the first to arrive, and thereupon select particular stations for themselves, where they await the advent of the females. A continual warfare is maintained by the males among themselves for the preservation of these stations, and also for the defence of their females. The strongest males are naturally successful in obtaining possession of the largest number of females; the number of females on the stations of the largest males usually varying from ten to fifteen or more.

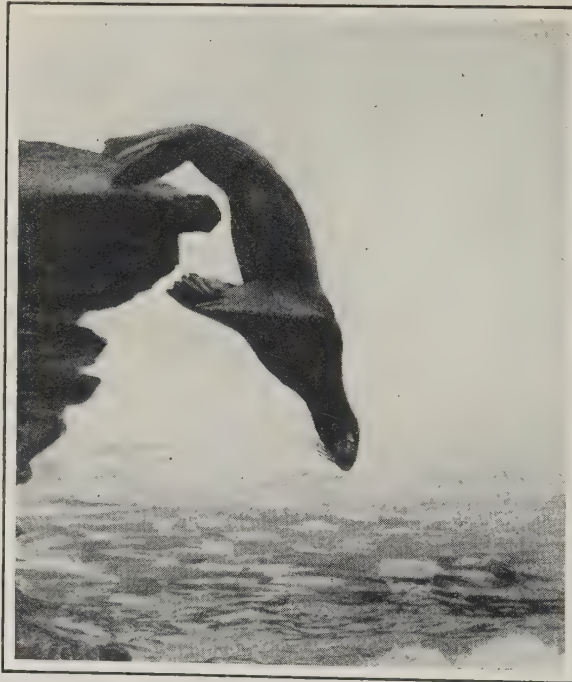
To guard such large harems requires constant vigilance on the part of the males, who remain on land throughout the whole breeding season, during which period they undergo an unbroken fast of several weeks' duration. When they first take up their stations

on land, the males are fat and in good condition, but at the end of their sojourn they become emaciated and weak to the last degree. The females, although after their arrival they remain continuously for a certain period on the stations of their lords, do not spend nearly such a long unbroken period on shore.

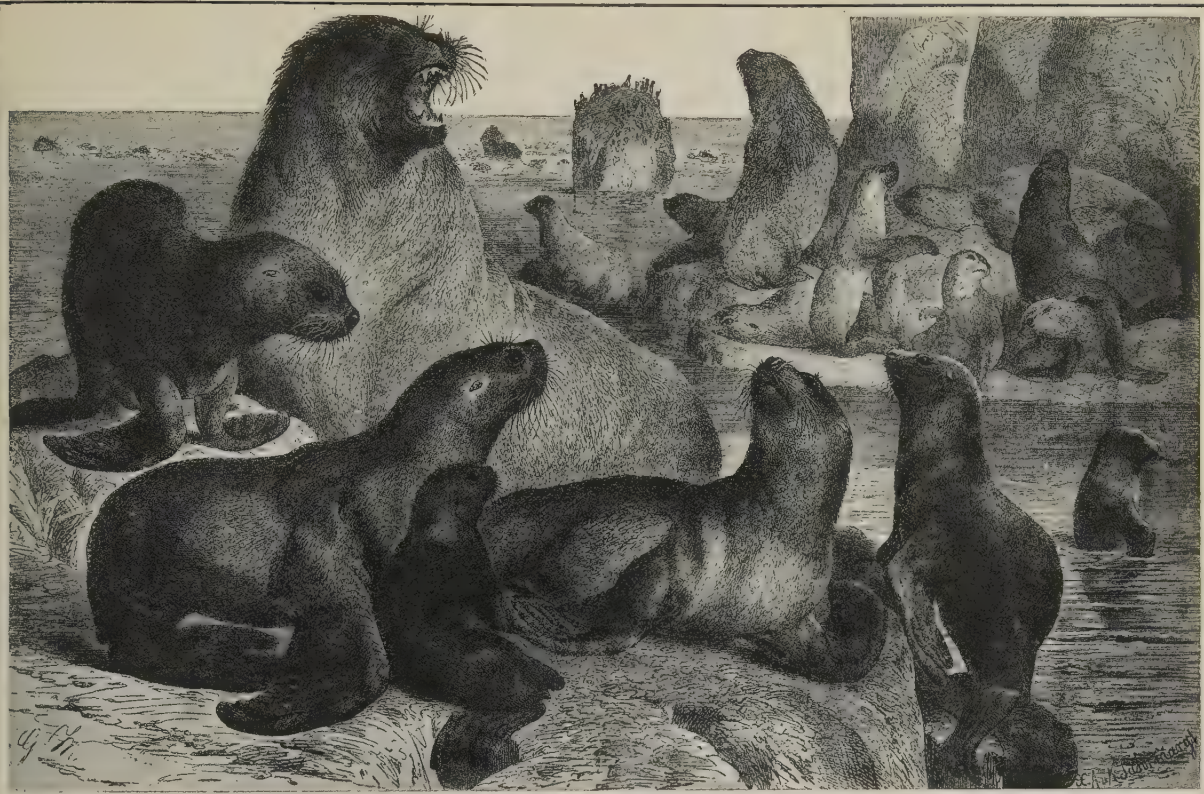
The larger members of the family are the sea-lions, or hair-seals, and the smaller, the sea-bears, or fur-seals. In colour the former are generally yellowish or reddish brown, although the Californian sea-lion is sometimes brownish black, and are usually darkest when young, and become lighter with age, a similar change being noticeable in individuals towards the moulting season. All the fur-seals, on the other hand, are black when young, but grow lighter with age, through an abundant mixture of greyish hairs which vary from yellowish grey to whitish grey. The

southern fur-seals are generally, when adult, much greyer than the northern. There is, however, much variation in colour among the members of a species according to age.

The fur-seals are, of course, far more valuable commercially than the sea-lions. The best skins are yielded by young males and females; and these are prepared for use by the inner layer of the skin being shaved away with a sharp knife, thus causing the long



SEA-LION DIVING



A FAMILY GROUP OF SOUTHERN SEA-LIONS

hairs, which are deeper rooted than the woolly under fur, to become loose when they are brushed out.

At the close of the eighteenth and during the early part of the nineteenth century fur-seals existed in countless numbers in many parts of the world; but human greed and folly have so reduced their numbers in most regions that their pursuit is no longer profitable, and though the seal rookeries of the Pribilof Islands in Bering Sea have been placed under restrictions as to the annual slaughter, pelagic sealing of the northern sea-bear by the Japanese threatens its extermination in the near future.

THE SOUTHERN SEA-LION

The southern, or Patagonian, sea-lion (*Otaria jubata*), which differs in certain respects both externally and internally from all the other species, inhabits the Galapagos Islands and the coasts of South America from Peru and Chile on the Pacific side, and from the Rio de la Plata on the Atlantic border, southwards to the Falkland Islands and Tierra del Fuego. Externally this species is distinguished from all the others by the long hair of the neck, which forms a kind of mane; although this mane is only indistinctly seen when the skin is wet. The profile of the head is nearly straight, the muzzle deep and somewhat truncated, and the naked portion of the nose large; while the upper lip has a number of thick bristles of considerable length, and hanging nearly straight down. The ears are also shorter than in any other member of the group.

There are likewise several features in the skull of this seal by means of which it can be distinguished from all the other eared seals, but it will suffice to mention that the palate is deeply hollowed out and truncated behind, whereas in the other species it is neither hollowed out nor truncated posteriorly. There are six

upper cheek teeth. The males of this species attain a length of about 7 feet from the tip of the muzzle to the root of the tail, although Captain Cook stated that in his time much larger individuals were to be met with.

This species was one of the first members of the group known in Europe, having been met with by Magellan so long ago as 1579, and at a much later date by Captain Cook. It was likewise the first exhibited alive in England, a specimen having been bought by the London Zoological Society in 1866. Afterwards other examples were obtained from the Falkland Islands by a French sailor named François Lecomte, and visitors to the Society's Gardens in Regent's Park in 1868 and a few years later were greatly interested by the docility and cleverness of these animals and their marvellous activity when in the water. Formerly these seals were extremely numerous in the Falkland Islands and on the coasts of Patagonia and other parts of South America, but they are now comparatively few, and their distribution is restricted.

The following particulars of the habits of the sea-lion in the Falklands were communicated by Lecomte on his return from the collecting expedition to Dr. James Murie. At various times they were seen in parties of from six to twelve, and even as many as twenty, but fifteen may be taken as the average. Several such families may congregate in the same creek, to the number of from forty to a hundred, but the individuals of different families do not associate with one another. They seem to prefer headlands or isthmuses, and choose the most southern localities there as resting-places.

One of the old males is always on guard as a sentinel. Usually he is seen perched on an eminence, and invariably with outstretched neck and upraised head, as if sniffing around for the slightest ominous warning. The signal of a grunt or growl sets the others on the

alert, and on any real approach of danger they all rush helter-skelter towards the water, from which they never wander far. Their daily occupation seems divided between sleeping and procuring food. They lie huddled together in a drowsy condition, or slumber, for a great part of their time, and this both during the day and night. At high tides, night and day, they take to fishing near the entrance of the freshwater rivulets into the sea. At such times they will remain a whole tide dabbling about singly after food. This consists of fish and crustaceans. In capturing their prey, they swallow it either above or below the water.

The sea-lions never drink water, this having been substantiated by the fact that the first specimen brought to England was kept for a year without fluid, except such as adhered to the fish with which it was fed. Ordinary seals have been observed occasionally to suck in water in the same manner as a horse would, but this is never done by sea-lions. The stomachs of these sea-lions, with the exception of young animals, always contain a certain quantity of pebbles, the amount varying from a few to many.

Each adult female gives birth to a single young one about the end of the year, equivalent to the northern midsummer. In the pairing season, which is in February and March, pitched battles occur between the males, during which the females look on quietly. At such times the males are savage, and if attacked will stand their ground. The old males generally utter a low kind of growl, but in the breeding season this is prolonged into a loud, voluminous, interrupted roar. The young utter a kind of bleating cry. From July to November the sea-lions migrate southwards from the Falklands. In colour the young are deep chocolate, but become paler after the first year; the old males are a rich brown tint, and the females greyer; at all ages and in both sexes the flippers are darker than the body.

THE NORTHERN SEA-LION

The northern sea-lion (*Otaria stelleri*) differs from the preceding species and agrees with all those that follow in the absence of a mane on the neck, the narrow and pointed nose, relatively long ears, and also in the flattened palate of the skull, which is not truncated behind. In the concave facial profile it differs from the southern sea-lion.

This is the largest member of the whole group, full-grown males measuring from 11 to 12½ or 13 feet in total length, of which the tail forms 3 or 4 inches; while the girth varies from about 8 to 10 feet, and the weight is estimated at from 1,000 to 1,300 lb.

In colour the young are rich dark chestnut-brown; but the adults, when they first reach the breeding grounds, are of a light brownish rufous in both sexes, the tint being darker between the fore limbs and on the under parts. Later in the season, however, the colour

changes to a golden rufous or ochrey tint; and when the new winter coat appears in November, the colour has been described as a light sepia, or Vandyke brown with deeper tints on the under parts; and at this season the females are distinctly lighter in colour than the males.

This fine sea-lion inhabits the shores of the North Pacific from Bering Strait southwards to California and Japan, and is one of the species found in the Prybilov Islands in Bering Sea; its northern limits being apparently determined by the southern border of the Polar floating ice. It was first discovered in 1741, during Bering's first expedition, and was described by the naturalist Steller who accompanied that navigator.

Mr. W. D. Elliot, writing of this species in the Prybilov Islands, observes that it has a really leonine appearance and bearing, greatly enhanced by the rich golden rufous of its coat and the ferocity of its expression. Although provided with flippers, to all external view the same as in the fur-seal, it cannot, however make use of them in a like free manner. While the fur-seal can be driven five or six miles in twenty-four hours, the sea-lion can barely go two, the conditions of weather and roadway being the same. The sea-lions balance and swing their long, heavy necks to and fro with every elevation of their hind quarters, which they seldom raise from the ground, drawing them up after the fore feet with a slide over the grass, sand, rock, and so forth, as the case may be, and pausing frequently to take a sullen and ferocious survey of the field and the drivers.

The males are less systematic and exacting in the formation and protection of their parties of females than is the northern sea-bear; and they are not known to travel so far inland. Moreover, these seals are very shy and wary, and never allow their haunts to be visited by man without making a sudden rush to the sea. The males leave the sea and take up their stations on the narrow belts of ground which they prefer early in May, while the females follow them after an interval of three or four weeks, thus arriving during the first weeks in June. Usually each male during the breeding season is accompanied by from ten



NORTHERN SEA-LIONS

to fifteen females. The latter are allowed to move freely from place to place; and are accustomed to go down to the shore, accompanied by their young—often carried by the nape of the neck—and disport themselves in the surf; such rambles being never undertaken by the female sea-bears. On the two main islands of the Prybilov group, known as St. Paul's and St. George's, it was estimated that not more than 25,000 of these seals were in the habit of visiting the former; while from 7,000 to 8,000 landed on the latter. The voice of this species is described as a deep, grand roar, forming a low, muttering growl.

THE NORTHERN SEA-BEAR

The sea-lions on St. Paul's Island are driven a distance of from ten to twelve miles along the shore to the village where they are to be killed; and from their slow rate of progress the journey is a long and protracted business, usually taking about five days. When once fairly started and accustomed to the presence of man, the seals are, however, readily controlled and kept in the desired direction. At the end of a day's journey they are allowed to refresh themselves by plunging in the pools found in many parts of the route. When thoroughly tired out at the end of a day's march, the unfortunate animals stretch themselves at full length on the ground, with extended limbs.

Finally, the herd reaches the village, when the sea-lions, being far too formidable animals to be despatched with clubs, are shot with rifles; the full-grown males being killed first, after which the fore part of the herd is driven back upon and over the rear, when the slaughter is continued by the hunters with lances.

THE CALIFORNIAN SEA-LION

The Californian sea-lion (*Otaria gillespii*) is by no means restricted to the country from which it derives its name, being found on both sides of the North Pacific, and is a much smaller species than the last, from which it is distinguished by the convex crown of the head, and the sudden descent of the profile at the eye; the side view of the head somewhat recalling that of a dog-faced baboon (page 419). The bristles on the side of the muzzle are also very small. The skull is characterised by its narrowness and elongation, and also by the great development of the bony crests on the brain case. The general colour is dark chestnut brown, becoming blackish brown on the under parts and limbs, but there is great seasonal and individual variation in this respect. The total length of adult males varies from 7 to 8 feet, these measurements being taken from the muzzle to the end of the outstretched flippers.

There has been some confusion as regards the habits of this species, owing to its having been confounded with the northern sea-lion. Both species occur on the Farallones Islands, near San Francisco, but the present species is by far the more numerous, and appears to be the only one represented on the neighbouring island of Santa Barbara. Mr. Elliot states that the two species may be distinguished by their voices, the northern sea-lion uttering only a deep, bass growl, and a prolonged, steady roar; whereas the Californian sea-lion never roars, but utters a sharp bark, sometimes almost approaching a howl.

These sea-lions feed almost, if not entirely, on cuttles and squids, and do not touch fish, the fact that sea-lions in captivity will eat fish rather than starve being no argument that they do so in their native state, when their stomachs are invariably found to be filled with the remains of cephalopods.

The Californian sea-lion is the species most commonly seen in captivity in Europe, as it thrives better than any other of the eared seals in that state. In captivity these seals display great affection for one another, and when one of a pair dies the survivor sometimes pines away and dies soon afterwards. From observations made on captive specimens in Chicago, it

appears that before the cub takes to the water the parent secretes a kind of oily fluid from her body, with which the hair of the cub becomes anointed, owing to both animals rolling on the same spot.

HOOKE'S SEA-LION

Hooker's sea-lion (*O. hookeri*) is a southern species of hair-seal, first obtained from the Auckland Islands, lying to the south of New Zealand, during the voyage of the Erebus and Terror. This species (page 469), of which examples have been exhibited alive in the London Zoological Society's Gardens, is subject to great variation in colour, some specimens being greyish, while others have a more or less markedly brown tinge. The head is distinguished from that of the preceding species by its nearly straight profile; the muzzle is of considerable length, the ear is of medium size, and the bristles on the muzzle are well developed.

The skull is characterised by the extreme narrowness of the palate, and has seven upper cheek teeth—in the latter respect agreeing with that of the southern sea-lion.

THE AUSTRALIAN SEA-LION

The hair-seal (*O. lobata*) inhabiting the seas of Australia forms a kind of connecting link between the hair and the fur seals, the cubs having a thick coat of soft under fur, which disappears in the adults. This indicates that the distinction between hair and fur seals is of no great zoological importance, although a convenient mode of classifying the members of this group.

In the Australian species the profile of the head is nearly straight, and the whole head large and massive, with rather small ears. The males are considerably darker than the females, and the cubs are black. From the presence of a stripe of rich deep fawn-colour, lighter than the general tint of the body, running across the hind part of the head, nape, and sides of the neck, the name of cowed seal has been applied to this species. The length of old males is from 8 to 9 feet, but probably few such specimens now exist. These seals were found abundantly in King George Sound and in Bass Strait; and the Seal Rocks off Port Stephens, to the north of Sydney, partly derive their name from the presence of colonies of this species.

THE NORTHERN SEA-BEAR

The well-known northern sea-bear, or fur-seal (*O. ursina*), is the first representative of the true fur-seals, and the only one found in the Northern Hemisphere. In this, as in all the other fur-seals, the coat is soft, with an abundant under fur; and the colour of the adult is some shade of dark grey, while the young are black. There are six pairs of cheek teeth in the upper jaw.

The northern sea-bear is distinguished from all the southern fur-seals by its extremely short face, in which the profile is nearly straight, and its relatively weak dentition. In the adult males the general colour of the upper parts, with the exception of the shoulders, is nearly black, with a more or less marked grey or reddish grey grizzle, but the shoulders are distinctly grey. The sides of the nose and lips are brownish, the breast is brownish orange, and the limbs and under



THE CALIFORNIAN SEA-LION

parts are reddish brown: The females are much lighter in colour, being uniformly grey above, with the under parts brownish or rufous. In both sexes the variations in colour are largely due to the different proportions of the grey in the hairs. The young when first born are of uniform glossy black, with the under fur lighter in hue and less abundant than is the case in the adults.

These seals are much smaller than the larger sea-lions, the old males measuring from 7 to 8 feet in length, and having a girth of from 6 to 7 feet; while their weight is estimated at from 700 to 800 lb. They do not attain their full size till about the sixth year. The females, which reach their full dimensions when five years old, measure 4 feet in length and $2\frac{1}{2}$ feet in girth, and weigh from 80 to 100 lb. The ears are absolutely longer than in the much larger northern sea-lion. The difference in the dimensions of the two sexes is greater than in any other member of the family.

The northern sea-bear inhabits both shores of the Northern Pacific, and is known to have been formerly abundant on the American side as far south as California, although the precise limits to which it once ranged in this direction have not been ascertained. On the Asiatic side of the Pacific its range embraced Kamchatka and the Kurile Islands, and extended as far as the southern extremity of Sakhalin Island, where it was still plentiful at the period of the Crimean War.

At the present day the headquarters of the sea-bear are the Prybilov Islands, known as St. Paul's, St. George's, Otter, and Walrus Islands; the first two being alone visited by the seals. Here the capture of the seals is strictly regulated, only a certain number being allowed to be captured annually.

During the winter the Prybilov Islands are deserted by these seals, which follow the southward migration of the fishes upon which they chiefly subsist. The old males are the first to revisit their haunts in the following spring; and a few of these may be found on the islands during the first week in May. At this time the males are very shy and sensitive, and remain near the shore; indeed, many of them will sometimes spend several days in swimming round the rocks before venturing to land. The first arrivals are not always the oldest, but rather the finest specimens of their race; and are always fully capable of maintaining possession of the stations they select immediately after coming ashore.

As a rule, the males do not reoccupy the same stations year after year, although sometimes some may do this for a few seasons. By June 1, or thereabouts, the damp, foggy weather of summer sets in, and with it the bull seals come up by hundreds and thousands, and establish themselves in advantageous positions for the reception of the females, which arrive three weeks or a month later. Then ensues the great struggle for positions on the land, those males which are the last to arrive, and also those occupying the posts nearest the

water's edge, having the utmost difficulty in maintaining their hold.

Frequently the fierce combats which then arise result in death; while some of the earlier arrivals which have taken up stations near the shore become exhausted by repeated struggles, and have to shift to more inland quarters. The fighting between rival bulls is

almost or entirely done with the mouth, the opponents seizing each other with the teeth, and clenching the jaws (page 133). Nothing but sheer strength can shake them loose, and that effort almost always leaves an ugly wound, the sharp tusks tearing out deep channels in the skin and blubber, or shredding the flippers into strips and ribands.

At this period the males give vent to four distinct cries, namely, a hoarse, resonant, long, and loud roar; a low, gurgling growl; a kind of hissing, chuckling, piping whistle, which must be heard to be recognised; and a sort of spitting sound and action, which is the most characteristic of all.

The females have only a bleating cry, used merely to attract the attention of the cubs; while the call of the latter is still more sheep-like. The seals when on land are extremely impatient of heat, a temperature of 48° being unpleasant, while at 55° to 60° they suffer great inconvenience. On such occasions they may be seen lying industriously fanning themselves with their flippers, sometimes holding the fore flippers vertically upwards as a kind of ventilator, while one or both of the hinder pair are employed as fans.

From their arrival until the end of the pairing season, which terminates during the first ten days of August, all the males which succeed in maintaining their posts never leave them for a single instant; and consequently never partake of either food or water for at least three months, while in some instances this fast endures for upwards of four months. During this time they subsist entirely on their own fat; and it is specially noteworthy that such a fast is very different from that endured by bears and other hibernating animals, during which most of the functions of the body are dormant. Nevertheless, no ill consequences appear to accrue, since the old male sea-bears come back year after year as fat and sleek as ever.

The females begin to arrive about June 12, and are all on shore by the middle of the following month. Each male near the shore has from about 12 to 15 females, and those inland from 5 to 8.

The cubs are born shortly after the landing of the females, coming into the world with their eyes open, and soon finding their voice and taking to the water. It is but rarely that there is more than a single cub at a birth. They weigh from 3 to 4 lb., and vary from 12 to 14 inches in length when born; their jet-black coat being retained for three months. Both parents seem to treat their offspring with indifference; and a cub which has strayed a short distance from the station



NORTHERN SEA-BEARS

THE SOUTHERN FUR-SEALS

of the father may be killed before the eyes of the mother without evoking any concern on her part. Although the males will often rush right into the middle of a whole party of cubs, it is seldom that any of the latter are killed.

After the birth of their offspring, the females make frequent visits to the sea, returning close to the spot where their cubs were left, each singling out her offspring by its cries without a moment's hesitation. The cubs are accustomed at an early period to collect in large numbers, and from the latter part of September to the time of departure in November they assemble in tens of thousands. Even among such numbers, the female instantly recognises the voice of her own offspring, and promptly makes her way to it, pushing through the throng, which she hustles to right and left. It is said that the cubs do not know their own mothers, but as they utter their cry at short intervals, the females have no difficulty when returning from the sea in finding their offspring.

After the first week in August the cubs nearest the shore make their first attempts at swimming, but are extremely awkward and quickly tire with their efforts. Soon, however, they become adepts in the art, and may then be seen sporting and frolicking in the water with the greatest enjoyment. By the middle of September all the cubs have become thoroughly familiar with the water, and have entirely deserted the higher grounds to take up a position on the rocks and beaches near the water's edge previously unoccupied by any of the seals. Finally, in November the islands are deserted by the great mass of the sea-bears, although some do not leave for their southerly migration until driven off by the snow and ice, as late as the end of December or January 12.

Mr. Elliot states that sea-bears of all ages "swim with great rapidity, and may be fairly said to dart along with the velocity of a bird on the wing under the surface of the water; and in all their swimming I have not been able yet to satisfy myself how they used their long, flexible hind feet, other than as steering mediums. The propelling motion, if they have any, is so rapid that my eye is not quick enough to catch it; the fore feet, however, can be very distinctly seen to work, feathering forwards and sweeping back flatly, opposed to the water, with great rapidity and energy, and are evidently the sole propelling power."

THE SOUTHERN FUR-SEALS

In the Southern Hemisphere there are four or five species of sea-bears, or fur-seals, all of which differ from the northern sea-bear in their much longer, narrower, and more depressed muzzles, and also in the fact that the flaps of skin projecting in advance of the toes of the hind flippers are much less elongated. The southern fur-seals are also, as a rule, decidedly greyer in colour than are the northern. There is still some uncertainty

as to the number of species belonging to this group, their resemblance to one another being so close that it requires an expert to distinguish between them.

The South American, or Falkland Islands, fur-seal (*O. australis*) inhabits the Galapagos Islands and the shores and islands of South America southwards from Chile on the western, and from the Rio de la Plata on the eastern side; being more numerous on the Falkland and South Shetland Islands than on the continent. The males attain a length of from 6 to 7 feet, while the females average about 5 feet; the disproportion between the sexes being thus much less than in the northern sea-bear. The fur is distinctly grey.

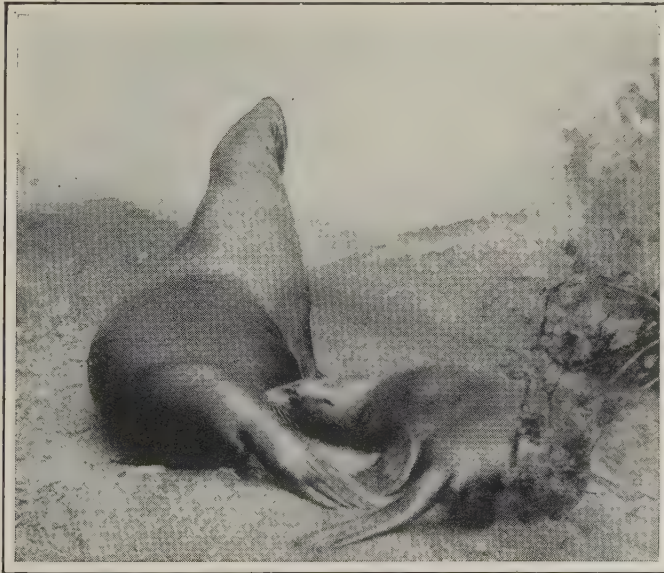
The habits of this species appear to be very like those of its northern cousin; the old males arriving on the Falklands before the females, and similar contests taking place for the possession of the latter, which arrive in December. The cubs are born during the same month, and are able to swim by February. The young males remain at sea during the greater part of the summer, not landing till February or March. They sojourn on land till the latter part of April, when they again take to the water; but towards the end of June they once more visit the shore for several weeks, remaining partly on land and partly in the sea. Like the sea-lions of the same regions, the southern fur-seals prey at times upon penguins.

The Cape fur-seal (*O. pusilla*) is a very well-marked species, characterised by the straight profile of the head, the overhanging and sharply pointed muzzle, the relatively long ears, and the extreme length of the numerous bristles depending from the upper lip. A

living example formerly exhibited in the London Zoological Society's Gardens had a whitish red fur grizzled with blackish hairs, while the under parts were of a reddish brown colour. This seal appears to be confined to South Africa, inhabiting the small islands round the Cape of Good Hope, as well as others some forty miles distant from Port Elizabeth. It is still fairly common, but its fur is of comparatively little value, owing to the shortness of the hair, although that of the young animals is longer.

There has been much uncertainty with regard to the fur-seals of the Australian seas, but it appears that there is really only a single

species, namely, the New Zealand fur-seal (*O. forsteri*), of which the so-called cinereous fur-seal (*O. cinerea*) seems to be the female. This seal, which is the only one found on the New Zealand coasts, also occurs on the Chatham Islands and the Seal Rocks near Port Stephens. Although formerly abundant, it is now becoming very rare. The males are usually dark grey above and brown below, while the lighter females are generally yellowish brown above and dark beneath, some of them having a crest of long, whitish hairs. While the fur of the male is valuable and beautifully curled, that of the female seems to have frequently but little under fur.



A SEA-LION SUCKLING ITS YOUNG

Photo. C. Peel

THE WALRUS

THE huge, ungainly animals known as walruses (from the Scandinavian *valross*, "whale-horse") constitute not only a distinct genus of the pinniped carnivores, but are the sole representatives of a special family, the *Odobenidae*, or *Trichechidae*. Walruses are strictly confined to the Arctic region of both hemispheres. The Pacific representative of the species, however, forms a distinct local race, *O. rosmarus obesus*.

In many respects the walrus (*Odobænus*, or *Trichechus, rosmarus*) is nearly allied to the sea-lions and sea-bears, this being specially shown in the structure of the hind limbs. The hind feet, for instance, are

the bivalve molluscs on which these animals so largely subsist.

In comparison with the size of the body, the head of the walrus is rather small, and while squared and abruptly truncated in front, is somewhat rounded behind; this rounded appearance being increased by the absence of all trace of external ears. The muzzle seems to be divided into two lobes by the vertical groove below the nostrils, and is furnished on each side with a number of stout translucent bristles growing from the upper lip. The eye is very small; and the entire head has a remarkably rugged and battered appearance, the lower jaw narrowing to a point between the upper tusks. The latter, which ordinarily project to a length of from 12 to 15 or more inches below the level of the gum, communicate the most characteristic feature to the head, and indeed to the whole animal. Although relatively longer than in the true seals, the neck is shorter than in the eared seals, and gradually thickens posteriorly, where it imperceptibly merges into the trunk. The body is extremely bulky and ungainly, with a rounded outline, and diminishes gradually in size from the shoulders to the hind quarters.

The tail is very small; and the limbs are to a great extent enclosed in the skin of the trunk. There are five rudimentary claws on both the fore and the hind feet, the soles of which are completely devoid of hair.

In the young of the walrus the body is thickly covered with short, yellowish brown fur, which is thinner and shorter on the under parts and limbs, where it also becomes of a reddish brown or

chestnut tinge. This fur persists till middle age, but in old age becomes gradually more and more scanty, frequently disappearing almost completely, or even entirely, from patches of larger or smaller extent; while in some very old males in the Pacific walrus the whole skin may be almost naked. The skin over the entire body is thrown into a number of folds and wrinkles, these folds being heaviest in the region of the shoulders; and the face is likewise strongly wrinkled.

The frequent fights in which these animals engage add a number of scars to the skin. Of four adult males measured by Dr. J. A. Allen, the smallest had a length of 9½ and the largest of 11 feet, from the tip of the snout to the root of the tail. Other examples, however, have been recorded, measuring somewhat more than 12 feet in length; but the statements that walruses 15 and 16 feet long have been met with must be received with hesitation. There is still much uncertainty as to the weight which these animals will attain. Parry gave the weight of an immature female as 1,550 lb.; while other trustworthy writers set down the weight of full-grown males at from 2,250 to 3,000 lb. Larger weights have, indeed, been suggested, but it is probable that the estimates were far too high.

In regard to the size of the tusks of the Atlantic walrus, a fine pair mentioned by Dr. Allen had a length of 24 inches, of which probably about 18 inches



YOUNG WALRUS AND HEAD OF
ADULT

capable of being turned forwards beneath the body, and are employed in locomotion on land; while they have the three middle digits much smaller than the outer pair. Moreover, the toes of the hind feet are terminated by large lobes projecting far beyond the extremities of the bones; and the fore limbs are nearly as large as the hind ones (page 91).

The walrus differs, however, from sea-lions and sea-bears in the total absence of external ears, and also in its massive and clumsy build, as well as in the number and structure of its teeth. In the adult animal the front portion of the skull, which is greatly swollen, carries a pair of very long and laterally compressed tusks, or canine teeth, depending from the upper jaw. Internally to these tusks there is usually a row of four small teeth, of which in the young state the first is situated in advance of the latter, and is therefore an incisor; the other three being premolars. The lower jaw has only four teeth on each side, of which the foremost corresponds to the upper tusk, while the other three represent the premolars. Consequently, an adult walrus has only eighteen teeth altogether.

The young animal has, however, two pairs of incisor teeth in both jaws, and five upper and four lower cheek teeth; these, with the tusks, bringing up the total number of teeth to thirty. The young walrus thus presents resemblances to the eared seals in respect to the number of its teeth which are totally lost in the adult animal. With the exception of the large upper tusks, all the teeth have low, blunted, subconical crowns, admirably adapted for crushing the shells of

THE WALRUS

protruded from the jaw during life ; the weight of each was 4 lb. Others have been obtained with a length of 31 inches, and a weight of upwards of 8 lb. apiece, but such are, now at least, extremely rare. The tusks of females seldom exceed 20 inches in length. In the Pacific walrus the tusks are stated to be longer and thicker, and more convergent, a pair from Kamchatka measuring 33½ inches in length.

In addition to this difference in the form of the tusks, the Pacific walrus has the muzzle proportionately broader and deeper, while the bristles on the upper lip are shorter and smaller. Important differences also occur in the form of the skull of the two races.

The geographical range of the walrus has been considerably restricted ; and unless it receive prompt and efficient protection it is one of those creatures which is doomed to extinction, this being more especially the case with the Pacific race. The Atlantic walrus was known in Europe during the latter part of the ninth century, and appears to have been hunted on the coast of Finmark about a century later, while by 1600 walrus-hunting was a regular trade. Occasionally these animals wandered as far southwards as the coasts of Scotland ; and they were abundant on many of the islands near the northern coast of Europe, and even on the shores of the continent, while eastwards their range extended into Asia as far as the River Lena. Relentless persecution has driven them to Spitzbergen, Novaya Zemlya, and other islands of the Arctic Ocean, where they occur in ever-decreasing numbers.

In America the Atlantic walrus formerly ranged from Nova Scotia to about latitude 80°, and was at one time abundant in the Gulf of St. Lawrence and on the eastern coasts of Newfoundland and Labrador ; but, according to Dr. A. S. Packard, the last walrus seen in the Gulf of St. Lawrence was killed in 1840, though a few have been observed since on some of the neighbouring coasts and islands. In Greenland about 1877 the walrus was only sparsely distributed in most places, with the exception of a tract lying between the 66th and 68th parallels, where it was sometimes met with in considerable numbers, and was regularly hunted by the natives in their canoes. Walruses also occur on the west coast of Baffin Bay and some of the islands to the north ; but their range appears to be limited by the western shore of Hudson Bay ; and as they are not again met with till Alaska, a large part of the coast of Arctic America is probably uninhabited by these animals.

Although the Pacific walrus has been known in Europe since the middle of the seventeenth century, it was not much molested by hunters till about 1860, by which date whaling had become much less profitable than formerly. The range of this walrus was always much more restricted than that of its Atlantic cousin, reaching from the limit of ice southwards on the American coast as far as latitude 55°, and on the Asiatic shores to latitude 60°. In longitude its range to the north of Bering Strait in the Arctic Sea was limited eastwards by Point Barrow in Northern Alaska, and westwards by Cape Tchelagskio on the northern coast of Siberia. As on the latter coast the range of

the Atlantic walrus did not extend eastwards of the Lena, the two races were widely separated from one another in this direction, as they also were in the opposite direction.

In past times the range of the Atlantic walrus was much more extensive than during the historic epoch, on both the eastern and western sides of the Atlantic. Its remains have, for instance, been dredged up from the Dogger Bank off the eastern coast of England ; while a skull was dug up from the peat near Ely, indicating that the animal formerly inhabited the valley of the Ouse, which was at that time probably an estuary. On the coasts of North America walrus bones have been dug up so far south as New Jersey, Virginia, and even California. At a still earlier period walruses considered to have belonged to an extinct species inhabited the eastern coast of England and the shores of Belgium ; numerous remains having been obtained from the Crag of the Pliocene period in both countries.

There appears to be no well-marked difference between the habits of the Atlantic and Pacific races. Walruses are, usually found in the neighbourhood of shores or masses of floating ice, and are seldom seen in the open sea. As a rule, they associate in companies or herds, depending in size upon the number in the particular locality. When on shore or on an ice-floe, the members of a party of walruses huddle together and press against one another like pigs. From April to June, according to the latitude, is the breeding season ; and during this period walruses remain on shore for about a fortnight, during which time they neither eat nor drink.

Usually there is but a single young produced at a birth, and never more than a pair. The young are stated to be suckled by the parent for upwards of two years, and it is hence believed that the same female breeds but once in every three years. The females while suckling their young assemble in herds apart from the males. Walruses have circular breathing-holes in the ice, to which they resort from below without exposing themselves. Their voice is a loud roar, which in the case of large herds can be heard at the distance of several miles.

Unless molested, the walrus is gentle and inoffensive in disposition, but when attacked displays great fierceness and vindictiveness, while its huge bulk renders it a formidable antagonist, especially when its aggressors are afloat in a small boat. Not less noteworthy is the affection of the female for its young, and likewise the sympathy of all the members of a herd for a wounded comrade. When one of the herd is wounded, its fellows combine for its defence ; and on such occasions the aspect of the animals is described as absolutely terrific. Either through confidence in their size and power, or lack of appreciation of danger, walruses, when on shore or on the ice, can often be approached very closely, and may thus be easily despatched ; they learn, however, greater caution with experience. In other cases they are more vigilant on all occasions placing



A YOUNG WALRUS

a certain number of their body to act as sentinels. In hunting them the great object is to cut off their retreat to the water, as if they once gain the open sea they generally escape.

The walrus feeds chiefly upon thick-shelled bivalve molluscs, especially those commonly known as gapers (*Mya*). For crushing the shells of these bivalves the stunted and short cheek teeth of the walruses are admirably adapted; but, after being broken, the shells are rejected and only the soft portions of the molluscs swallowed. This diet is supplemented by fish and various crustaceans; while, in addition to these, large quantities of seaweed are also swallowed, although it is probable that their introduction into the creature's mouth is not intentional. The chief use of the tusks of the walrus is to dig in the mud and ooze for the purpose of raking up the molluscs on which it feeds so largely.

Dr. Robert Brown states, however, that he has seen walruses employ their tusks to aid in dragging their unwieldy bodies on to the ice, and also to aid their clumsy progress when on land. These observations are confirmed by Dr. E. Kane, who states that he had known walruses drag themselves on rocky islands in this manner to heights of sixty or a hundred feet above the level of the water.



A BABY WALRUS

The walrus is killed, when on land or ice, by means of long lances, or with rifles; while when at sea it is chased with special boats and harpooned. It is hunted for the sake of its oil, hide, and tusks. The yield of oil is proportionately less than in the seals, the amount obtained from the largest specimens seldom exceeding

500 lb., and the quality is also stated to be inferior to seal-oil. The hides are chiefly exported to Russia and Sweden, where the leather is used for harness and the soles of boots and shoes, and also is twisted into tiller ropes. In thickness the skin varies from 1 to 1½ inches. More valuable are the tusks, although their ivory is far inferior to that of elephants.

The first living walrus was brought to England so long ago as 1608, and the second in 1853; while another pair was exhibited in the London Zoological Gardens in the autumn and winter of

1908. Others have been shown from time to time in Mr. Carl Hagenbeck's zoological park at Stellingen, near Hamburg.

Another Scandinavian name for the walrus is morse, while to the Inuits of Greenland the animal is known as the awuk.

TRUE, OR EARLESS, SEALS

THE typical, or true, seals, which form the third and last family (*Phocidæ*) of the pinniped carnivores, are distinguished from the sea-lions and sea-bears on the one hand and from the walruses on the other by the characters of the hind limbs, which are permanently directed backwards, and conjointly form a kind of rudder-like organ. Then, again, there is no trace of external ears, and the neck is shorter than in either of the other families. The front limbs are always smaller than the hind ones, and the first digit or thumb of the former is always longer than the other toes, while the whole of the digits are furnished with well-developed claws situated at their extremities. The hind feet, which are incapable of the great expansion characterising those of the eared seals, usually have all the digits armed with claws, and generally want the long flaps of skin at their extremities which characterise those of the eared seals. The number of front or incisor teeth is variable in the different groups; but there are constantly five pairs of cheek teeth in each jaw, of which the first four belong to the premolar series. In all the species the under surfaces of both the fore and hind feet are covered with hair, while the fur clothing the body is invariably stiff and devoid of any woolly under fur.

The true seals form a much more varied group than the eared seals, and are arranged under several distinct genera; the total number of species being about sixteen or seventeen, although there is still doubt whether some forms should not be regarded as merely local races instead of species. Most of the genera have only a single species each, and in only one of the genera does the number of species exceed two.

True seals occur along the shores of the temperate and colder portions of the globe, but the greater number are found in the Northern Hemisphere. Moreover, with

the exception of the sea-elephants, the seals of the Northern Hemisphere belong to genera distinct from those inhabiting the Southern Hemisphere, and the whole of the Arctic species are generically distinct from those of the Antarctic regions. The majority of true seals are characterised by their strongly developed social instincts and their extraordinary affection for their young. In disposition they are gentle and submissive, offering no resistance when attacked by man, although the crested seal of the North Atlantic is an exception in this respect.

Many of the species are accustomed to assemble in large flocks during the breeding season, while others are gregarious at all periods of the year. Although sea-elephants pass several weeks during the breeding season on land, none of the true seals undergoes a prolonged fast at this season. As a rule, a single young one is produced at a birth, and there is never more than a pair. All seals are in the habit of spending a large portion of their time basking in the sun on sandy beaches or ice-floes.

Their food, of which a large quantity is necessary, consists chiefly of fishes, but also comprises crustaceans and molluscs, and most of the species, like sea-lions, are in the habit of swallowing a number of pebbles.

From the absence of external ears and the structure of their hind limbs, true seals are evidently more specialised animals than sea-lions and sea-bears, and are thus more completely adapted for an aquatic life. This is shown by the long period they can remain under water without coming up to breathe. According to Dr. R. Brown, the average time of a seal's submergence is from five to eight minutes, while the limit is set down by the same observer at a quarter of an hour. Other authorities, however, state that the

THE GREY SEAL

time may be twenty or thirty minutes. The sounds uttered by seals are various, in some cases taking the form of a kind of barking note, while in others they assume a more bleating tone, or even resemble the cry of a child, the note of the young being always more plaintive and less hoarse than that of the adult. In no cases, however, do seals utter barking roars comparable to those of sea-lions.

The strange circumstance that young seals take to the water reluctantly, and have to be taught the art of swimming by their parents, appears to be a sufficient indication that seals are originally descended from land carnivores. Among some species the young remain entirely on the land or the ice for the first two or three weeks of their existence, or until they have shed their first coat of woolly hair. Numbers of seals are destroyed by the Polar bear, while others fall victims to the rapacious killer-whale. Others, again, are frequently destroyed by being jammed between ice-floes, thousands being sometimes killed in this way. The reduction in their numbers by all these causes is, however, trivial compared to those inflicted by man, who, according to Dr. J. A. Allen, requires about a million and a half to supply his annual needs.

So reckless, indeed, has been the destruction of seals that some species are already well-nigh exterminated, while others have been so reduced in numbers as to render their pursuit no longer profitable. Several species inhabiting the Northern Hemisphere make long migrations, moving southwards to avoid the intense cold of winter, and returning northwards in summer; such migrations being most marked in the Greenland and the hooded seal.

From the conformation of their hind limbs, most seals are unable to progress on land in the manner characteristic of sea-lions and walruses; both the latter being able to bring their hind limbs under the body by arching the back and carrying forward the hind feet by a kind of jerk. Very generally seals move on land merely by a kind of wriggling motion of the body, with the fore limbs held close to the sides of the trunk and the hind limbs stretched out straight behind. It has, however, been ascertained that in the case of the Greenland and crested seals there is a kind of motion somewhat intermediate between the above and that characteristic of the eared seals.

According to Dr. J. Murie, the former species "very often uses its fore limbs, placing these on the ground in a semi-grasping manner, and, by an alternate use of them, drags its body along. The hind legs meantime are either trailed behind slightly apart, or with opposed plantar surfaces slightly raised and shot stiffly behind. On uneven ground, or in attempting to climb, a peculiar lateral wriggling motion is made; and at such times, besides alternate palmar action, the body and the hind limbs describe a sinuous spiral track." On the other hand, the common seal appears far less capable of making use of its fore limbs in progression on land, these being only occasionally employed to obtain a hold on rocks.

On smooth ice seals are able to move forwards with considerable rapidity, the average rate being about one mile an hour in cool weather. Such journeys are

always undertaken at night, and the seals advance by raising their bodies from the ice by means of the fore limbs, and then drawing themselves forwards. On land seals occasionally travel considerable distances, and it is on record that in the winter of 1829 a grey seal in Norway travelled through the snow a distance of fully thirty miles; the time occupied in accomplishing this journey being believed to have been about a week, during which period the creature could not have touched food.

The seals are not a very ancient group, geologically speaking, although their remains are found throughout the Pleistocene and Pliocene strata, and in a portion of those belonging to the Miocene period. Fossil seals are very common in the Pliocene deposits of Belgium, most of these being more or less nearly allied to the species inhabiting the Northern Hemisphere.

GREY SEAL

The grey seal (*Halichærus grypus*), which is the sole representative of its genus, belongs to a group confined to the Northern Hemisphere, and distinguished from all other members of the family by the presence of three pairs of incisor teeth in the upper jaw and two pairs in the lower. A further characteristic is to be found in the presence of claws on all the toes of both pairs of limbs, while all those of the hind feet are of nearly equal length.

The grey seal may be distinguished from the other members of this group by the fact that the crowns of the relatively large cheek teeth carry only a single conical cusp, although there may occasionally be fore-and-aft cusps in the last two teeth of the lower jaw. Another feature of these teeth is that, with the exception of the last one or two in the upper and the last one in the lower jaw, each is implanted in the jaw by a single root.

The grey seal is a rather large species, full-grown males usually measuring about 8 feet in length, although occasionally reaching as much as 9 feet; these measurements being taken from the tip of the nose to the end of the hind feet. The general colour of the fur is silvery or yellowish grey, becoming lighter on the under parts, and marked with a number of blackish or dusky ill-defined spots. There is, however, great variation in this respect, some specimens being uniformly silvery or yellowish white, with little or no trace of spots, while others are almost black. The young are always white or yellowish white at birth, but, as a rule, soon acquire darker tints.

The grey seal is one of the least common of the northern members of the family, and has a somewhat restricted distribution, being



HIND FLIPPERS OF RINGED SEAL

A. Open B. Closed

only found within comparatively narrow limits in the North Atlantic. On the shores of Northern Europe it appears to be commoner than on the American side, and it occurs in Iceland, Scandinavia as far north as Finmark, the British Isles, and probably Greenland. It seems to be unknown in Spitzbergen and the islands of the Arctic Sea, and is not met with, at all events as a regular inhabitant, on the shores of the English Channel, although it is comparatively common on certain parts of the west coast of Ireland. On the American coast it extends as far south as Sable Island, off Nova Scotia,

while northwards it is met with occasionally in the Straits of Labrador and Belle Isle, and ranges as far as Diskö Island.

With the possible exception of the bearded seal, the present species is peculiar in breeding in the autumn, the young being produced in the Shetland Islands from September to November. There the grey seal is commonly found associating in pairs, and frequenting the most exposed positions. It is less docile and less intelligent than the common seal, and cannot be tamed in the same manner. A specimen measuring 8 feet in length weighed nearly 400 lb.

TYPICAL SEALS

The common seal (*Phoca vitulina*) is the best-known example of the typical genus *Phoca*, the members of which differ from the grey seal in their smaller and more pointed teeth, but more especially in the fact that each of the cheek teeth, with the exception of the first in each jaw, is implanted by two distinct roots, and has its crown composed of three or four compressed cusps arranged in a line. In such a tooth there is one large main cusp in the middle, which corresponds to the single cusp of the teeth of the grey seal, while in front and behind this are one or two much smaller cusps.

The common seal (page 418), which is the only species in addition to the grey seal ordinarily met with on the coasts of the British Isles, is one of three nearly allied species, which in the young condition cannot always be satisfactorily distinguished from one another by colour alone, these three species being the common seal, the ringed seal, and the Greenland seal. All three are much smaller than the grey seal, the ringed seal (*P. hispida*) being the smallest of all. The Greenland species may always be distinguished from either of the others by the greater length of the first digit in the fore feet, which exceeds that of the other toes.

When adult, the ringed seal is blackish grey above, with oval whitish rings, and whitish on the under parts; its usual length varying from 4½ to 5½ feet. The common seal, on the other hand, may be distinguished from the other two by its more massive teeth; the cheek teeth being very broad and thick, and set obliquely and close together in the jaws, instead of being placed in the same straight line, and separated from one another by distinct intervals. It is, moreover, a relatively stouter-built animal, with a larger head, broader nose, and shorter limbs. The union between the two halves of the lower jaw is short, whereas it is of considerable length in the adult of the ringed seal.

The adult of the common seal is very variable in colour, but the usual tint of the hair on the upper parts is some shade of yellowish grey, with irregular dark brown or blackish spots; the under parts being yellowish white, generally marked with smaller spots of brown. The length of the male varies from 5 to 6 feet. The new born young are yellowish white, and shed their woolly coat either on the day of birth or shortly after.

The common seal has a much wider distribution than the grey seal, occurring not only in the North Atlantic but also in the North Pacific, and extending on the shores of both oceans to the Arctic regions, and thus being doubtless circumpolar. In the Atlantic it is found, though rarely, as far southwards as the Mediterranean, and on the American side as far as New Jersey. In the Pacific its southern limits appear

to be marked on the Asiatic side by Kamchatka, and on the American by Southern California. It is, moreover, by no means confined to the coasts, but ascends some of the larger tidal rivers to a considerable distance from their mouths, and has been known to pass up the St. Lawrence to the great lakes. In the North Atlantic this seal is strictly littoral in its habits, and always avoids the ice of the open seas. It is very common in Spitzbergen and Greenland, and once frequented certain parts of the British shores, but has been banished from many places where it was familiar. It is still common on many parts of the Irish coast, and among the Scottish islands, especially Shetland and Orkney,

and in Wales and Cornwall is well known. The name of Selsey—that is, "seals' island"—testifies to its having been numerous at one time on the south-eastern coast of England.

The common seal does not make any seasonal migrations, but is found in the same haunts throughout the year. It prefers sheltered sounds and bays, with shallow water and an abundant supply of fishes, to more exposed positions, and leaves the water at every tide to rest on the rocks or beach, almost invariably selecting such rocks as are separated from the mainland. The young are born in the latter part of May or June, and take to the water at an early period. Like other members of the family, this seal is readily attracted by music, and will follow boats from which sounds proceed to a considerable distance. Whether, however, this attraction by musical sounds is due merely to the curiosity characterising all the pinniped carnivores, or to an appreciation of the music itself, has not been ascertained.

In disposition the common seal is gentler and more intelligent than most of its congeners; these qualities being displayed not only in the care and affection it bestows on its offspring, but likewise by the readiness with which it can be tamed, and its fidelity and affection for its masters. There are, indeed, many instances where these seals have followed their owners about like a dog, and some where they have come back to a house after every effort had been made to drive them away.

THE GREENLAND SEAL

Although the Greenland, or, as it is often called, the harp, or saddle-backed, seal (*Phoca grænlandica*) in its immature condition is not easy to distinguish from the



SEALS SWIMMING

THE BEARDED SEAL

common seal, in the case of adult males of the two species there is no difficulty in this respect, the peculiar colouring of the Greenland species being amply sufficient. In the adult male the colour is yellowish white or white, the nose and fore part of the head to behind the eyes are black, and there are very generally some black spots on the throat and chest. The most characteristic mark, however, is the irregular crescent-like band of black on each side of the body, extending from the shoulders nearly to the tail; these bands being widest where they unite in the middle line over the shoulders. They may be interrupted posteriorly, but more generally join once more in front of the tail, so as to enclose an ellipsoidal area.

The length of the male is usually from 5 to 5½ feet, but may be as much as 6 feet. The female has much the same colouring as the male when adult, but the black markings are less distinct and may be wanting. The full colouring is not attained till the fifth year, and so different is the appearance of the animal at different stages of its growth that the Greenlanders have distinct names for it according to age. The white or yellowish white woolly fur of the young is not exchanged for the hairy coat till several weeks after birth.

The Greenland seal, which is only a very occasional visitor to the British Isles, is essentially a northern species, ranging in the Atlantic from Newfoundland and the North Sea to the Arctic regions, and also occurring in the North Pacific.

The most noted breeding stations are Newfoundland and the vicinity of Jan Mayen, at which localities these seals may be seen in enormous herds in the spring, but where they pass the remainder of the season is not ascertained. In Greenland they visit the coasts both in the autumn and in the spring, and it may be some of these herds that pass westwards to Jan Mayen. During their migrations the seals keep close to the coasts, and frequently enter the bays and estuaries; but when settled at their breeding haunts they prefer exposed ice-floes in the open sea, never resorting to the shores, and being seldom met with on the firm ice. Everywhere the Greenland seal is in the habit of assembling in immense herds, and it is so abundant that its numbers probably exceed those of all the other species put together. In consequence of this abundance, this species forms the main basis of the sealing trade of the northern seas.

Unlike the bearded and ringed seals, the Greenland seal never forms a breathing-hole in the ice; and this is doubtless the reason why it frequents the ice-floes rather than the continuous stretches of unbroken ice. Off the coast of Newfoundland the young are born in the early part of March, but in the Jan Mayen district not until the end of that month. When assembled in their countless herds on the ice-floes during the breeding season, their cries may be heard at a distance of several miles, more especially if the ear be applied to the ice.

THE RINGED SEAL

In addition to the features already mentioned, the ringed seal (*P. hispida*) differs from the common

seal in its more slender form, longer limbs and tail, narrower head, and more pointed nose. The ringed seal is an inhabitant of the Arctic and North Atlantic and Pacific Oceans, occasionally visiting the British Isles, but it may be regarded as pre-eminently boreal, its true home being the Arctic seas. Its favourite resorts are sheltered bays and fjords, in which it remains so long as they are filled with solid ice; but when this breaks up the seals betake themselves to the ice-floes, upon which the young are born in the months of March and April. The ringed seal is not a migratory species, and in some localities is found in considerable numbers. It is one of those seals which make a circular "blow-hole" in the ice, through which they can ascend or descend at pleasure; such apertures being made while the ice is forming.

The Baikal seal (*P. sibirica*) and the Caspian seal (*P. caspica*), which are confined to the inland seas from which they take their names, may be regarded as small local races of the ringed seal, and are very similar to one another. Their especial interest is derived from their habitat; the Baikal seal inhabiting a freshwater lake, while the waters in which the Caspian seal dwells are slightly salt. The curious thing is that neither Lake Baikal nor the Caspian Sea appears to have had any recent connection with the Arctic Ocean; and if, as is most probably the case with the latter, we have to look to a former connection with the ocean southwards, it becomes difficult to see whence came the stock from which these two allied seals were derived. It has been suggested that the ringed, the Baikal, and the Caspian seal may be all descended from an allied extinct species, the remains of which are found in the Pliocene deposits of Belgium.

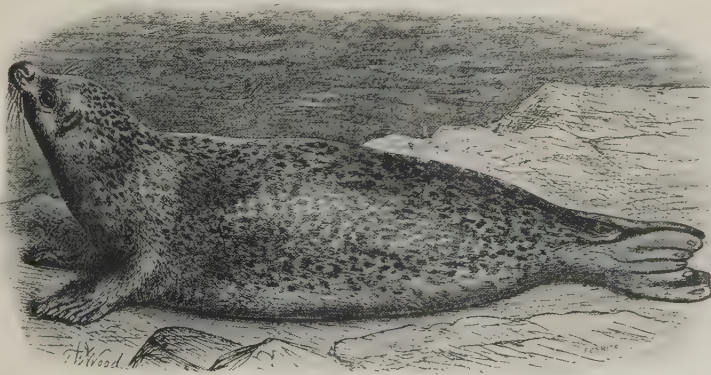
THE BEARDED SEAL

Another species is the bearded seal (*P. barbata*), distinguished from all the other members of the genus by its superior size, its broad muzzle, and convex forehead, as well as by its small and weak teeth, some of which generally fall out in the adult. Moreover, the front flippers differ from those of all the other species in having the third or middle digit longer than the rest; in the other species the digits decreasing in size from the first or first and second together. The colour of

the bearded seal is some shade of grey, darker on the middle of the back than elsewhere, but varying considerably in different individuals. In distribution the bearded seal is circumpolar and almost exclusively boreal, its only migration in winter being due to the extension of the unbroken ice-fields, by which it is compelled to move somewhat to the south. On the American side of the Atlantic this

seal extends as far as Labrador, but not apparently down to Newfoundland. It is abundant on the coasts of Greenland, but in Europe does not occur farther south than Iceland and the North Sea.

The bearded seal is by far the largest of all the northern seals, full-grown males attaining a length of about 10 feet, and an adult female skeleton measuring 7 feet 2 inches. The species, which is nowhere abundant



THE COMMON SEAL

is more or less solitary in its habits, never congregating in large herds. It is fond of basking upon large pieces of floating ice, and generally keeps well out to sea, where it is easily approached and killed by the Eskimo.

A distinctive peculiarity is its habit of turning a complete somersault when about to dive, especially when fired at. The skin is thicker than that of any other northern seal, and is consequently valued by the Eskimo, who employ it in making their harpooning lines. A very distinct species is the banded seal (*P. fasciata*), of the North Pacific, which takes its name from being marked with broad bands of brown on a buff ground, thus forming a distinctive and striking type of colouring.

MONK-SEALS

The monk-seal (*Monachus albiventer*) belongs to a group differing from the preceding in having only two pairs of incisor teeth in both the upper and lower jaws, and also in the first and fifth toes of the hind feet being much longer than the others, and having their claws either rudimentary or absent. With the exception of the first in each jaw, the cheek teeth are implanted by double roots; and the total number of teeth is thirty-two, against the thirty-four of the last group. The monk-seal is distinguished from the other members of its own group by the character of its cheek teeth, these being large, hollowed on the inner side, and marked with a prominent ring at the base, while the cusps on either side of the main cusp are very small. Another character is that the claws on all the toes are small and rudimentary. The fur is short, dark brown mingled with grey on the upper parts, and whitish beneath. Full-grown males attain a length of from 7 to 8 feet, or more.

Together with the West Indian seal (*M. tropicalis*) and the sea-elephant, the monk-seal is the only species of the family inhabiting the warmer seas; it is found in the Mediterranean and Black Seas, and on the coasts of the neighbouring portions of the Atlantic, extending to Madeira and the Canary Islands. Although little is known of its habits in a wild state, the monk-seal is readily tamed, and is the species at one time exhibited in England as the "talking-fish."

The West Indian seal is of nearly the same colour as the monk-seal in the adult state, but the young are deep, glossy black. This species is interesting from its restricted distribution and the prospect of its impending extermination. Although discovered so far back as 1494 by the flotilla of Columbus, when cruising in the West Indies, this seal, up to 1883, was represented in scientific collections only by a single skin sent to the British Museum in 1846 by Mr. P. H. Gosse. In 1687, when Sir Hans Sloane visited the Bahamas, these seals were extraordinarily abundant, the sealers sometimes killing as many as a hundred in a single night; but in less than two centuries they had become exterminated from most of their former haunts, although some were known to remain on the rocky islands of Pedro Keys, to the south of Jamaica. In 1886 a vessel visited three small islands lying between

Yucatan and Florida, known as the Triangles, with the hope of finding a colony of these seals; and in this hope the expedition was not disappointed, upwards of forty specimens being secured before the vessel was compelled to put back from stress of weather.

The seals of this group have the first and fifth toes of the hind feet much longer than the others, and since this is a character which they possess in common with sea-lions, it is interesting to note that the West Indian seal has the power of bringing the hind feet forwards to a certain extent when on land by curving the body upwards. When straightening itself, this seal pitches ahead on its breast, advancing about a foot in the operation.

ANTARCTIC SEALS

The leopard-seal (*Og-morhinus leptonyx*), which is a large, handsomely coloured species, was for many years the best-known representative of a group of four genera confined to the southern and Antarctic seas, each containing a single species. These seals differ from the monk-



THE GREENLAND SEAL

seal in certain characters of their skulls, and are likewise separated from that species and from another by the form of their cheek teeth (page 544).

The leopard-seal, or, as it is often called, the sea-leopard, is distinguished by the great length of its skull, and by the cheek teeth consisting of three large and distinct cusps. The middle and largest of these cusps has its tip slightly inclined backwards, while the summits of the two smaller cusps are curved towards the middle one. Adult males attain a length of as much as 12 feet. In some degree these handsome seals approximate in colouring to the common seal, the short and glossy fur being spotted with yellowish white and dark grey on the back, and the under surface having a general yellowish colour. The females are usually darker than the males, in which the ground colour of the fur is often of a silvery grey.

The leopard-seal has a wide distribution in the southern temperate and Antarctic seas, having been recorded from the coasts of New Zealand, Australia and the adjacent islands, the Falkland Islands, Kerguelen Land, and the shores of Patagonia, and being also found on the pack-ice in the Antarctic Ocean. It does not appear to be migratory, and is sometimes found on the ice or on islands in considerable herds.

THE CRAB-EATING SEAL

The second member of this group of Antarctic seals is the crab-eating seal (*Lobodon carcinophagus*), in which, during winter, the coat is creamy white—whence the alternative name of white seal—although in summer this white livery is changed for a silky greyish brown dress, with more or less mottling on the shoulders, flanks, and sides of the head, as well as on the dark brown flippers. The cheek teeth are even more complex than those of the leopard-seal, having one cusp in front of the large main cusp, and from one to three distinct cusps behind the latter. The claws of the hind feet are represented by minute nails. This species frequents the Antarctic pack-ice, where it is locally abundant.

SEA-ELEPHANTS

WEDDELL'S SEAL

Weddell's seal (*Leptonychotes weddelli*) is another Antarctic species distinguished by the teeth having simple conical and somewhat compressed crowns, without additional fore-and-aft cusps. It was originally obtained from the Southern Orkneys, but has also been obtained from Patagonia and the Antarctic pack-ice. The general colour is very similar to that of the leopard-seal, being pale greyish above, spotted with yellowish white on the back, and yellowish beneath, but the jaws are weaker and the sockets of the eyes larger than in that species.

ROSS'S SEAL

The last of these four southern species is Ross's seal (*Ommatophoca rossi*), long known merely by two skulls and a single skin obtained from the Antarctic pack-ice during the voyage of the Erebus and Terror in 1839-1843, and appropriately named after the commander of that expedition. The fur is rough and coarse, steel grey or greyish brown in colour, marked with oblique grey stripes on the sides of the body and paler on the under parts. There are no claws on the hind feet, and only very small ones in front. The skull is characterised by the immense capacity of the sockets of the eyes and by the small size of the teeth. The cheek teeth have very small fore-and-aft cusps.

The great peculiarity of this seal is its power, when on land, of puffing out the chest and throat in a manner recalling a pouter pigeon. It has also remarkable vocal powers. In accordance with its feeble dentition, its food consists of cuttlefish and seaweed. This species is nowhere common. In one skull the place of one of the usual complex teeth is taken by two complete simple teeth, this being a case where an originally single tooth divides into two distinct teeth of simpler type.

CRESTED SEAL

The remarkable species known as the crested, hooded, or bladder seal (*Cystophora cristata*), is distinguished from other members of the family by the large and soft prominence crowning the fore part of the head of the males. This species, together with the sea-elephants, also differs from all the seals yet noticed in having only thirty teeth, owing to the reduction of the incisors to two pairs in the upper and to one pair in the lower jaw. In both species the cheek teeth are small and simple, with, in general, only a single root each; and in the males of both the nose is furnished with an appendage which can be inflated at will.

What is the precise use of the cap has not yet been determined, but from its presence in the males only it may be inferred to be a sexual feature analogous to the antlers of deer.

The first and fifth toes of the hind feet are considerably longer than the three middle ones, and furnished with long lobes projecting in advance of the rudimentary claws, or the position which these should occupy.

In the crested seal the appendage on the nose takes the form of a large bag-like cap, which is in communication with the nostrils, and when inflated covers the head as far back as the eyes; but the female has no

trace of this appendage, which does not make its appearance in the male till a considerable time after birth. The hind feet are provided with small claws; and the last cheek tooth generally has two roots. The ground colour of the fur is bluish black, becoming lighter on the flanks and under parts, and marked with small irregular whitish spots; the head and limbs being uniformly black. Sometimes, however, the ground colour is light greyish white, varied with dark brown or blackish spots. The woolly fur of the newly born young is pure white.

In respect of size, full-grown males vary from $7\frac{1}{2}$ to 8 feet in length; females measuring about .7 feet. The skull is very short and broad, and the bony partition dividing the nostrils is produced above the level of their margin in order to support the cap. This seal is restricted to the colder regions of the North Atlantic and certain portions of the Arctic Sea; its range extending from Greenland eastwards to Spitzbergen, and thence along the northern coast of Europe. Southwards these seals are seldom found below Norway on the one side, and Newfoundland on the other.

In habits the crested seal is migratory and pelagic, travelling south in winter, and preferring the drift-ice of the open sea to the neighbourhood of land; indeed, it very seldom, if ever, resorts to the shores or even to outlying rocks. Although at times the sexes live apart, they usually associate in family parties or small herds during the breeding season, previous to which the males engage in fierce contests for the possession of the females. During these fights the males utter cries audible at a distance of several miles. The young are born on the ice, far away from land, during March; and in defence of their offspring both parents will lose their own lives rather than escape by flight.

The crested seal is fiercer and bolder than any of the other members of the family, and often turns upon its aggressor, so that its pursuit in the frail kayaks, or canoes, of the Eskimo is attended with some danger, the protection afforded to the head by the inflated cap rendering the males difficult to kill by means of clubs. In addition to fishes, the crested seal feeds largely upon cuttles and squids.

SEA-ELEPHANTS

In the gigantic species known to sailors as sea-elephants, but by naturalists often termed elephant-seals, the appendage on the nose of the male takes the form of a short trunk or proboscis, which, though generally hanging in a limp condition, can be expanded and dilated at the will of its owner. The end of this proboscis is obliquely truncated, and penetrated by the nostrils, and the whole organ communicates a peculiar anatomy to the animal. The



HEAD OF MONK-SEAL

female resembles an ordinary seal in the form of the head. The teeth are very small in proportion to the size of the head, those of the cheek series being of simpler structure than in the crested seal, and each inserted by a single root only. In the hind feet the claws are wanting, and their first and fifth toes are longer in proportion to the others than is the case in the crested seal.

Sea-elephants (page 93) are the largest of all the pinnipeds, not even excluding the walrus, adult males attaining a length of from 15 to 16 feet to the end of the body, or, reckoning from the tip of the trunk to the extremities of the outstretched flippers, a length of 20 or 22 feet. When in good condition, the girth of an old male may be as much as 15 or 16 feet, while the yield of oil from such an animal may reach 210 gallons. The females are much smaller, not exceeding 9 or 10 feet in length. The general colour of the coarse and short fur is grey, with a more or less marked blackish or olive tinge, darker on the upper than on the under parts.

The southern sea-elephant (*Macrorhinus falclandicus*), of which there are several local races, distinguishable by the characters of the skull, formerly inhabited many of the islands in the South Atlantic, Pacific, and Indian Oceans, as well as those in the Antarctic Sea, some of its favourite haunts being the Falkland Islands, Kerguelen, Crozet, and Heard Islands, South Georgia, the South Shetlands, Tristan d'Acunha, and the Macquarie and Chatham Islands, near New Zealand. In such places, during the earlier portion of the nineteenth century and in the preceding one, this and the next species were met with in enormous herds, as described in the accounts of the voyages of Cook, Péron, and Anson.

Northwards this species reaches Patagonia, and extends some distance up the western coast of South America. On the island of Juan Fernandez, and also north of the Equator and some distance north of the tropic of Cancer these seals are met with between latitude 25° and 35° on the coast of California, where they are represented by the northern sea-elephant (*M. leoninus*), which differs from its southern representative by the longer and more slender trunk of the males, and is further characterised by certain features in the form of the bones of the skull. None of the northern animals appears to be so large as the gigantic southern sea-elephants from Heard Island, the maximum length of the former being apparently about 16 feet.

In the southern seas sea-elephants have been almost exterminated from the Falkland Islands; and at the time of the visit of the Challenger, Professor Moseley stated that while these seals had completely disappeared from Tristan d'Acunha, they were still to be met with on Marion Island, were comparatively numerous on Kerguelen Island, and on Heard Island occurred in thousands. They still survive in the Macquarie and Chatham Islands, and the Crozets and Falklands.

On Kerguelen Island sea-elephants arrive for the purpose of breeding in August, and depart in the following February or March, so that their stay on land includes the whole of the southern summer.

When once on shore, sea-elephants show little disposition to move, lying in groups on some grassy stretch to which there is easy access by means of a sandy landing-place. Frequently they excavate deep trenches in the sand, in which one or two individuals can lie more comfortably than on the flat. They are slow crawlers at best, using only the fore flippers to haul themselves along, but at the same time wriggling the body with a kind of snake-like action.

No account of the Carnivora would be complete without some allusion to a number of peculiar species occurring in the Oligocene and Eocene formations of Europe and America which differ so remarkably from all living terrestrial representatives of the order as to render it imperative to refer them to a totally distinct group. These extinct primitive, or, as they are



LEOPARD-SEALS

technically called, creodont, Carnivora differ from modern land Carnivora in the absence of a distinct flesh tooth in either jaw; all the molar teeth of each jaw being constructed on the same plan, and the whole of those in the lower jaw being frequently like the single flesh tooth of other Carnivora. As a rule, the crowns of the upper molar teeth are triangular in form and of the type noticed on page 346. In all existing Carnivora the two bones in the upper row of the wrist, technically known as the scaphoid and lunar, are completely welded together, but in nearly all the Creodontia they remain quite distinct. Another feature is the small size of the brain of the creodonts.

These and other characters indicate that these primitive Carnivora are a much more generalised group than the modern land Carnivora, of which they were almost certainly the direct ancestors. The teeth of many of these extinct Carnivora are, moreover, so like those of the carnivorous marsupials as to have suggested the possibility of a direct connecting link between marsupials and placental Carnivora, although the idea of such a relationship is now rejected by most naturalists.

In size these creodont Carnivora range from that of a fox to that of a brown bear, three of the best-known genera being those described under the names of *Hyænodon*, *Pterodon*, and *Cynohyænodon*. These are of Oligocene age, and seem to have been derived from a more primitive North American and African type named *Sinopa*, which has cheek teeth very like those of an opossum.

It seems probable that the Eocene fox-like American Carnivora included in the genus *Vulpavus* were the direct descendants of creodonts, and in their turn gave rise to many of the modern Carnivora. The intermediate stages between *Vulpavus* and modern Carnivora were probably occupied by the Oligocene genera *Amphictis* and *Cynodictis* (pages 427 to 480).

ORDER V.—RODENTS

GENERAL SKETCH OF THE GNAWING MAMMALS

By R. LYDEKKER

UNDER the common title of gnawing, or rodent, mammals is grouped that extensive assemblage of small or medium-sized species which, like rats, porcupines, beavers, squirrels, and hares, are characterised by their habit of gnawing. Rodents, order Rodentia, are much more numerous than are the members of any other mammalian order, both as regards individuals and species, the number of the latter being probably nearly two thousand.

The great majority of rodents are inhabitants of the dry land, and a large proportion of them seek protection from enemies by living in subterranean burrows which they construct for themselves, and in which they associate in larger or smaller colonies. Some, however, like the water rat and the beaver, are aquatic; while others, like squirrels and tree porcupines, lead an arboreal life. A few, again, like flying squirrels, have acquired the power of spurious flight owing to the development of folds of skin along the sides of the body and limbs, by the aid of which they are enabled to take long flying leaps.

Rodents are some of the most easily defined of all mammals, and are best characterised by the number and nature of their teeth—especially those in the front of the jaws. They are distinguished by the presence in each jaw of a pair of large chisel-like front, or incisor, teeth, which grow continuously throughout life. As a rule, no other incisor teeth save these two pairs are developed, but in the hares and rabbits and their allies a second smaller pair occurs behind those of the upper jaw. There are no tusks, or canine teeth, in either jaw, and in the cheek series the number of premolars is always reduced below the normal four, very generally only one pair of these teeth being present, while in some cases even these may be wanting. In consequence of the reduced number of incisor teeth, coupled with the absence of canines and the reduction in the premolars, the skull of a rodent is always distinguished by a long gap between the front and the cheek teeth.

Indeed, the presence in all rodents of only a single pair of chisel-shaped and permanently-growing lower incisors, opposed to a corresponding pair in the upper jaw, the total absence of canines, the long gap between the incisors and the cheek teeth, and the reduction in the number of the premolars, are of themselves sufficient to distinguish the order from all other mammals, with the exception of the aye-aye (page 285).

Among other distinctive characteristics of the group, the following may be mentioned. The feet are usually furnished with five toes, which generally terminate in sharp claws, although they sometimes have broad nails. In walking, either the whole or the greater part of the sole of the foot is applied to the ground, so that these animals may be described as entirely or partially plantigrade.

Rodents are nearly always furnished with collar-bones (clavicles), although these may be more or less

imperfectly developed, and are thereby broadly distinguished from all living Ungulata, or hoofed, mammals. The skull is characterised by the condyle of the lower jaw being elongated from front to back, instead of from side to side, and thus permitting of that backwards-and-forwards motion of the lower upon the upper jaw, which is so noticeable when we watch a rabbit feeding; this character serving to distinguish rodents alike from ungulates and from carnivores. Another point in connection with the skull is that the cavity for the eye is not separated behind by a bar of bone from the temporal fossa; this feature distinguishing rodents from the aye-aye, in which the eye socket is surrounded by a bony ring.

The teeth being so important in the definition of the rodents require somewhat fuller consideration. With regard to the incisors, it may be observed that they are of great length, and curved nearly in the arc of a circle; their inserted portion extending far backwards into the jaws, so that in the upper jaw it comes nearly in contact with the base of the first of the cheek teeth, while in the lower jaw it runs beneath the whole of that series. The lower incisors form a small segment of a very large circle, roughly speaking, while the upper ones constitute a much greater segment of a far smaller circle.

In the great majority of rodents the enamel on the incisor teeth is confined almost exclusively to the front surface, and is generally thicker on one side than on the other; but in the hares and rabbits it also extends to some extent on the lateral surfaces. In cross-section these teeth are somewhat triangular; the front enamel-covered surface being broad and flattened, and the two lateral surfaces gradually converging to a rounded posterior edge. But while the inner surface, which comes in contact with the tooth on the opposite side of the jaw, is nearly flat, the outer surface is convex.

As a natural result of the front surface of these teeth being composed of the hard enamel—which is very frequently of an orange or reddish colour—and the

remaining portion of much softer dentine, or ivory, the effect of wear is to produce a sharp chisel-edge at their summits. Indeed, the structure of an incisor tooth of a rodent is precisely analogous to a chisel; the hard enamel corresponding to the steel with which the latter is faced, and which forms the cutting edge, while the ivory represents the soft iron forming the support to the thin plate of steel. As these incisor teeth are continually growing, they always present the same chisel-like edges, which are worn away by use at a rate commensurate

with the growth. It follows that if one of these teeth be broken away during life, the corresponding tooth in the opposite jaw, having nothing to check its growth by wear, will continue to grow uninterruptedly till it forms nearly a circle, when its point will enter the jaw of its unfortunate owner and probably lead to a lingering death. Most museums possess specimens of skulls showing this



SKULL OF A RAT, SHOWING ABNORMAL GROWTH OF UPPER INCISOR TEETH

Photograph by F. R. Hinkins & Son

The cheek teeth of rodents may be either provided with distinct roots, or may grow throughout life and never develop such roots. In the cases of those with distinct roots, the crowns may carry mere simple tubercles or cusps; but in other instances they may have their summits or sides penetrated by infoldings of the enamel, thus producing a more or less complicated pattern when worn. On the other hand, the permanently-growing rootless molars always have complex crowns, which are sometimes interpenetrated by lateral infoldings of the enamel, and at others are divided into a series of parallel transverse plates.

There is, indeed, a precise parallelism in this respect between the molar teeth of the rodents and those of mastodons and elephants; the molar tooth of a mouse, which has distinct roots and a low crown with simple cusps, being exactly comparable to that of a mastodon, whereas the high-crowned laminated, and rootless molar of a guinea-pig corresponds as closely with that of a modern elephant. Rodents are always furnished with milk teeth, which in some instances are shed before birth.

Rodents present a peculiarity in the structure of the mouth quite unknown in any other mammals. Behind the upper front teeth the outer hairy skin of the face is continued inwards into the sides of the mouth, which by this means is divided into two distinct chambers, communicating with one another through a comparatively narrow orifice: the first chamber contains only the front teeth, while the cheek teeth are included in the second chamber. This arrangement prevents the entrance of foreign substances into the true cavity of the mouth when the creatures are engaged in their characteristic operation of gnawing. In addition to this peculiarity, the whole of the inside of the cheeks in the hares and rabbits is covered with hair; while the pouched rats and hamsters have large pouches inside the cheeks, which are also lined with hairy skin. On the other hand, the pouched gophers have pouches in the cheeks which open externally instead of internally.

Rodents have a wider distribution than any other group of terrestrial mammals, being found in all parts of the globe except the extreme Polar regions. With the exception of bats, they include the only representatives of the placental mammals undoubtedly indigenous to Australia. They are, however, but poorly represented in that country and in the great island of Madagascar. On the other hand, the order attains an extraordinary development in South America, where its largest representatives occur. In time, the rodents certainly date from the upper portion of the Eocene division of the Tertiary period; where the whole of the extinct forms hitherto discovered exhibit all the essential peculiarities of the existing representatives of the group. The lower Eocene strata of North America have, however, yielded the remains of a genus

known as *Mixodectes*, which, together with certain allied forms, is believed to indicate an ancestral group of rodents, the Proglires, apparently not far removed in structure from the primitive Carnivora and Primates of the same epoch.

The whole of the rodents are almost entirely herbivorous in their habits; and all obtain their food by gnawing. Of the terrestrial forms the hares are among

the fleetest runners of all mammals, while the jerboas and chin-chillas are distinguished by their leaping powers. Rodents are mostly harmless and inoffensive creatures, fleeing with the greatest terror and precipitancy from the smallest of foes; but a few, like the rat, when driven to bay, will defend themselves desperately, and inflict comparatively severe bites with their powerful front teeth.

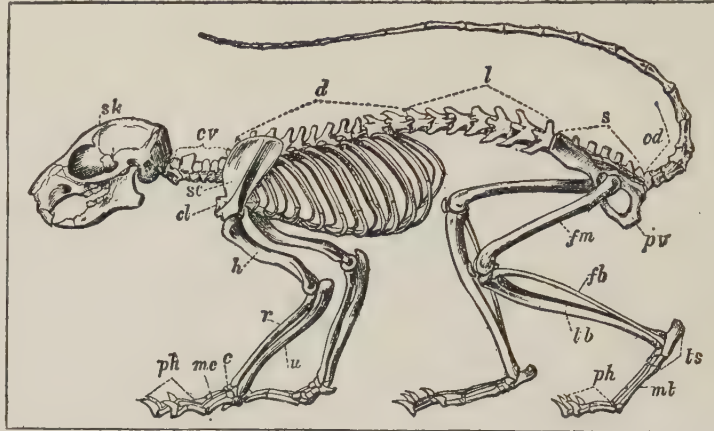
Many rodents yield furs which are very largely used in commerce, although, with the exception of beaver skins, of less

intrinsic value than are those of many other mammals. The flesh of hares and rabbits forms in Europe a favourite article of diet, while that of certain other members of the order is also eaten in various parts of the world; but the strong odour which characterises many rodents renders their flesh more or less unpalatable.

As a whole, rodents are characterised by their dull and frequently uniform colouring, although there are numerous exceptions. Indeed, many of the squirrels from the warmer regions of the globe, as well as one of the species of marmots, are among the most brilliantly coloured of all animals. In the brighter-coloured forms it does not appear that any rule can be laid down as to the plan of colouring. Thus while in many of the squirrels the brilliant colours take the form of distinct patches, distributed over various parts of the body, in the palm squirrels and ground squirrels there are light longitudinal stripes on a dark ground, while in the pacas there are light-coloured spots. It appears, however, that no rodent exhibits transverse bars of different colours on the body, and in none is the tail ornamented with alternate light and dark rings.

The tail itself is very variable, being totally wanting in the guinea-pig, while in the jerboas it attains an enormous relative length (pages 140 and 367).

Apart from Carnivora, whose ravages are in the main confined to wild and uncivilised countries, rodents are by far the most destructive of all mammals to the human race; the highest position in this black list being occupied by the members of the rat and mouse tribes, nearly all of which are more or less injurious to crops, pasture, or grain in settled countries; the loss inflicted throughout the world would indeed be absolutely appalling were it possible to estimate its magnitude. The swarms of field-mice which from time to time make their appearance in cultivated lands afford another instance of the enormous damage done by rodents; while the rabbit-plague in Australia is a still more serious infliction on account of its being continuous.



SKELETON OF A SQUIRREL

c, carpus (wrist); cd, vertebrae of tail; cl, clavicle (collar-bone); cv, vertebrae of neck; d, vertebrae of back; fb, fibula; fm, femur (thighbone); h, humerus (upper arm); l, vertebrae of loins; mc, metacarpus; mt, metatarsus; ph, phalanges (toe-bones); pb, pelvis (haunch bone); r, radius; s, sacral vertebrae; sc, scapula (shoulder-blade); sk, skull; tb, tibia (shin-bone); ts, tarsus (ankle); u, ulna.

TABLE OF RODENTS

It is not, however, solely as enemies to agriculture and grain-stores that the members of the rat tribe inflict harm on mankind, as the brown rat is the chief carrier of plague, which, however, originates with the bobac marmot. It seems that while the brown and its relative the black rat are equally susceptible to plague, the incidence of this disease is twice as great in the former as in the latter, the brown rat being chiefly responsible for the diffusion of plague among the rats of Bombay. This greater prevalence of plague among brown rats is due to the fact that they harbour twice as many fleas—the actual propagators of the disease—as do the black rats.

In this connection it is important to notice that in the four great ports of India and Burma, the brown rat is common both in Bombay and Calcutta, is not uncommon in Rangoon, but is totally unknown in Madras. On the other hand, the great bandicoot rat (*Nesocia bandicota*) is rare in Bombay, uncommon in Calcutta, and absent from Rangoon, but extremely plentiful in Madras. In Calcutta the few bandicoots burrow in the sides of the tanks of that city, but in Madras they inhabit outhouses and drains, and thus occupy the places held elsewhere by the brown rat. This leaves no room for the latter species in Madras, as it is no match in strength and fighting power for its larger relative.

Confirmation of this is afforded by the fact that in Rangoon the brown rat is to be found in much smaller numbers than in Calcutta or Bombay, this being probably due to the presence in the first-named of a small species of bandicoot (*N. varia*), which, like the brown rat, is an outdoor species, and must compete with the latter. Since, however, the Rangoon bandicoot is so much smaller than the Madras species, the brown rat can exist with it, although prevented from flourishing to the same extent as in Bombay and Calcutta.

Now, Madras is the one Indian port which does not harbour the brown rat, and also the one which has never been seriously infected with the plague, and hence it seems practically certain that this species is the great plague-carrier, although it must not be forgotten that

plague persists in certain provinces of India where the brown rat is seldom or never seen.

The insanitary effect of the brown rat may be inferred from the fact that where this species is abundant there must be more interchange between ship and port rats than in a harbour like Madras, where the great bandicoot rat, which probably never boards ships, is the common species. The brown rat is the commonest sea-going species, and the greatest carrier of plague in this way also. Information, however, is still defective as to the proportions in which brown and black rats are found in ships in tropical seas; but the observations available indicate that vessels in which one species has taken up its quarters will not be infested by the other.

Against the losses inflicted by rats and field-mice on the farmer, a slight set-off may be credited in America to the labours of the little burrowing rodents commonly known as pocket-gophers, and their effect on the soil. True earth-worms are unknown in Manitoba, and, indeed, in all that part of North America lying to the south of the Saskatchewan and west of the Mississippi, with the exception of a narrow humid belt along the Pacific coast; and it would seem that the work performed by worms in other parts of the world is accomplished in western North America by pocket-gophers.

In Manitoba the surface consists of a layer of black soil from a foot to two feet in thickness, and there can be little doubt but that this layer, which is a solid bed of decayed vegetation, has been thoroughly mixed up with the subjacent loam by the action of burrowing rodents, foremost among which are pocket-gophers.

Squirrels also aid the forester by planting nuts and the mast of beech and maple trees, which may, however, be only a poor compensation for the havoc they do to trees.

So far as classification is concerned, the order may be sub-divided into three suborders, namely, the simple-toothed, double-toothed, and blunt-toothed rodents; the first including the squirrel-like, mouse-like, and porcupine-like groups; the second, the hares and picas; and the third, certain extinct types.

R. LYDEKKER

TABLE OF RODENTS DEALT WITH IN THIS WORK

ORDER V		SPECIES		GENUS 11	
Rodents, or Gnawing Mammals—Rodentia		Cape ground squirrel	<i>Geosciurus capensis</i>	Prairie Marmots— <i>Cynomys</i>	
SUBORDER 1		GENUS 5		SPECIES	
Simple-toothed Rodents—Simplicidentata		Funisciurus		<i>Cynomys ludovicianus</i>	
FAMILY 1		SPECIES		Columbian prairie marmot	
Scale-tailed Squirrels— <i>Anomaluridae</i>		Paul's Squirrel		<i>C. mexicanus</i>	
GENUS 1		GENUS 6		GENUS 12	
Scale-tails— <i>Anomalurus</i>		Palm Squirrels— <i>Funambulus</i>		Marmots— <i>Arctomys</i>	
SPECIES		SPECIES		SPECIES	
Equatorial scale-tail	<i>Anomalurus pusillus</i>	Indian palm squirrel ..		Alpine marmot	
Red scale-tailed squirrel	<i>A. fulgens</i>	GENUS 7		Bobac	
GENUS 2		Giant Squirrels— <i>Ratufa</i>		Himalayan marmot	
Zenkerella		SPECIES		Long-tailed red marmot	
SPECIES		Indian giant squirrel		Cabul marmot	
Flightless scale-tail	<i>Zenkerella insignis</i>	Malay giant squirrel		Golden marmot	
GENUS 3		Golden-backed giant squirrel		A. aureus	
Idiurus		Irawadi giant squirrel		Woodchuck	
SPECIES		GENUS 8		Rocky Mountain marmot	
West African scale-tail	<i>Idiurus zenkeri</i>	Typical Squirrels— <i>Sciurus</i>		Hoary marmot	
FAMILY 2		SPECIES		GENUS 13	
Squirrels— <i>Sciuridae</i>		European squirrel		Lesser Flying Squirrels— <i>Sciuropterus</i>	
GENUS 1		Red squirrel, or chickari		SPECIES	
Groove-toothed Squirrels— <i>Rhithrosciurus</i>		Grey squirrel		American lesser flying squirrel ..	
SPECIES		GENUS 9		volucella	
Groove-toothed squirrel	<i>Rhithrosciurus macrotis</i>	Ground Squirrels, or Chipmunks— <i>Tamias</i>		Kashmir lesser flying squirrel	
GENUS 2		SPECIES		Pigmy flying squirrel	
Spiny Squirrels— <i>Xerus</i>		Common chipmunk		S. spadiceus	
SPECIES		Long-eared chipmunk		Polatouche	
Abyssinian spiny squirrel	<i>Xerus rutilus</i>	Siberian chipmunk		GENUS 14	
GENUS 3		GENUS 10		Larger Flying Squirrels— <i>Pteromys</i> (<i>Petaurista</i>)	
Atlantoxerus		SPECIES		SPECIES	
SPECIES		Eversmann's suslik ..		Taguan	
Lesser spiny squirrel	<i>Atlantoxerus getulus</i>	European suslik		Hodgson's flying squirrel	
GENUS 4		Striped gopher		Brown flying squirrel	
African Ground Squirrel— <i>Geosciurus</i>		Long-eared gopher		Red flying squirrel	
		Richardson's gopher		Spotted flying squirrel	
		Parry's suslik		Sze-chuen flying squirrel	
				P. melanopterus	
				GENUS 15	
				Woolly Flying Squirrel— <i>Eupetaurus</i>	
				SPECIES	
				Grey woolly flying squirrel	
				Eupetaurus cinereus	

HARMSWORTH NATURAL HISTORY

GENUS 16
Pigmy Squirrels—Nannosciurus
SPECIES
Whitehead's pigmy squirrel Nannosciurus
whiteheadi

GENUS 17
West African Pigmy Squirrel—Myosciurus
SPECIES
African pigmy squirrel Myosciurus minutus

FAMILY 3
Extinct Horned Rodents—Mylagaulidae

GENERA
Mylagaulus
Ceratogaulus
Epigaulus

FAMILY 4
Beavers—Castoridae
GENUS

Beavers—Castor
SPECIES
European beaver Castor fiber
American beaver C. canadensis

FAMILY 5
Sewellels—Haplodontidae
GENUS

Sewellels—Haplodon
SPECIES
Common sewellel Haplodon rufus
Californian sewellel H. major

FAMILY 6
Dormice—Gliridae
GENUS 1

Dormice—Muscardinus
SPECIES
Common dormouse Muscardinus avellanarius

GENUS 2
Squirrel-tailed Dormice—Glis
SPECIES

Squirrel-tailed dormouse Glis esculentus
Tree dormouse G. nitedulus
Tirolese dormouse G. intermedius

GENUS 3
Garden Dormice—Eliomys
SPECIES

Garden dormouse Eliomys quereinus

GENUS 4
African Dormice—Graphiurus
SPECIES

Cape dormouse Graphiurus ocularis

GENUS 5
Indian Spiny Mouse—Platacanthomys
SPECIES

Malabar spiny mouse Platacanthomys lasiurus

FAMILY 7
Jumping Mice and Jerboas—Dipodidae
GENUS 1

Jumping Mice—Zapus
SPECIES

Jumping mouse of North America Zapus

Jumping mouse of Sze-chuen Z. szechuanus

GENUS 2
Five-toed Jerboas—Alactaga
SPECIES

Alagadaga Alactaga saliens
Afghan jerboa A. indica
Four-toed jerboa A. tetradactyla

GENUS 3
Yarkand Jerboa—Euchoretes
SPECIES

Long-eared jerboa Euchoretes naso

GENUS 4
Flat-tailed Jerboas—Platycercomys
SPECIES

Flat-tailed jerboa Platycercomys platurus

GENUS 5
True Jerboas—Dipus
SPECIES

Egyptian jerboa Dipus jaculus

GENUS 6
Sminthus
SPECIES
European sminthus Sminthus subtilis
Chinese sminthus S. concolor
Kashmir sminthus S. leathamii

FAMILY 8
Mouse Tribe—Muridae
GENUS 1

Water Rats of Australia—Hydromys

SPECIES
Australian water rat Hydromys chrysogaster

GENUS 2
Queensland Rat—Xeromys
SPECIES

Queensland rat Xeromys myoides

GENUS 3
New Guinea Water Rat—Crossomys
SPECIES

Monckton's water rat Crossomys moncktoni

GENUS 4
Chrotomys
SPECIES

Whitehead's rat Chrotomys whiteheadi

GENUS 5
Giant Rat—Phlaomys
SPECIES

Whip-tailed giant rat Phlaomys cumingi

GENUS 6
Shrew-nosed Rat—Rhynchomys
SPECIES

Shrew-nosed rat Rhynchomys soricoides

GENUS 7
Gerbills—Gerbillus
SPECIES

Indian gerbil Gerbillus indicus

GENUS 8
Veldt Rats—Otomys
SPECIES

Veldt rat Otomys bisulcatus

GENUS 9
Tree Mice—Dendromys
SPECIES

South African tree mouse Dendromys
mesomelas

GENUS 10
Climbing Mice—Deomys

GENUS 11
Hamsters—Cricetus
SPECIES

Hamster Cricetus frumentarius
Caucasian hamster C. nigriculus
Rumanian hamster C. newtoni
Grecian sand hamster C. atticus
Sze-chuen sand hamster C. obscurus
Siberian sand hamster C. songarus
Long-tailed dwarf hamster . . . C. camensis
Long-tailed dwarf hamster of Sze-chuen . . C.
triton

GENUS 12
White-tailed Rats—Mystromys
SPECIES

South African white-tailed rat Mystromys

Central African white-tailed rat M. longi-
caudatus

GENUS 13
Malagasy Rats—Nesomys

GENUS 14
White-footed Mice—Peromyscus
SPECIES

Common white-footed mouse Peromyscus
americanus

GENUS 15
Rice-field Mice—Oryzomys
SPECIES

Rice-field mouse Oryzomys palustris

GENUS 16
Calomyscus
SPECIES

Bailward's mouse Calomyscus bailwardi

GENUS 17
Fish Rats—Ichthyomys
SPECIES

Stolzmann's fish rat Ichthyomys stolzmanni
Soderstrom's fish rat I. soderstromi

GENUS 18
Earless Fish Rat—Anotomys
SPECIES

Earless fish rat Anotomys leander

GENUS 19
Rheomys
SPECIES

GENUS 20
Groove-toothed Mice—Rhithrodontomys
SPECIES

American harvest mouse Rhithrodontomys
humilis

GENUS 21
Groove-toothed Mice of South America—
Rhithrodon
SPECIES

Rabbit-like rhithrodon Rhithrodon cunicu-
loides

GENUS 22
Wood Rats—Neotoma
SPECIES

Florida wood rat Neotoma floridana
Bushy-tailed wood rat N. cinerea

GENUS 23
Crested Rats—Lophiomyes
SPECIES

Abyssinian crested rat Lophiomyes imhausi

GENUS 24
Water Rat and Voles—Microtus (Arvicola)
SPECIES

Water rat Microtus amphibius
Short-tailed field mouse M. agrestis
Continental field mouse M. arvalis
Orkney field mouse M. orcadensis
Eastern field mouse M. ratticeps
Sanday field mouse M. sandayensis
Red-backed field mouse M. glareolus
Alpine field mouse M. nivalis
Short-tailed meadow mouse M. riparius
Root mouse M. oeconomus
Royle's field mouse M. roylei

GENUS 25
Lemmings—Lemmus (Myodes)
SPECIES

Norwegian lemming Lemmus norvegicus
Siberian lemming Myodes obensis

GENUS 26
Banded Lemming—Dicrostonyx
SPECIES

Banded lemming Dicrostonyx, or Cuniculus
torquatus

GENUS 27
Musk Rats—Fiber
SPECIES

Musquash Fiber zibethicus

GENUS 28
Mole Voles—Ellobius
SPECIES

Mole vole Ellobius talpinus
Quetta vole E. fuscicapillus
Caucasian vole E. lutescens

GENUS 29
Prometheomys
SPECIES

Schaposchnikow's mouse Prometheomys
schaposchnikowi

GENUS 30
Zokor—Myotalpa
SPECIES

Zokor Myotalpa aspalax

GENUS 31
Rats—Mus
SPECIES

Brown rat Mus norvegicus
Black rat M. rattus
Mouse, or house mouse M. musculus
Long-tailed field mouse M. sylvaticus
Harvest mouse M. minutus
Australian brown-footed rat M. fuscipes

GENUS 32
Striped Mice—Arvicanthi
SPECIES

Barbary striped mouse Arvicanthi barbarus

GENUS 33
Pandicoot Rats—Nesocia
SPECIES

Great Indian bandicoot rat Nesocia bandicota

GENUS 34
Bush Rats—Golunda
SPECIES

Indian bush rat Golunda ellioti

GENUS 35
Spiny Mice—Acanthomys

GENUS 36
Bushy-tailed Giant Rat—Crateromys
SPECIES

Schadenberg's bushy-tailed giant rat Cratero-
mys schadenbergi

GENUS 37
Jerboa Rats—Conilurus

GENUS 38
Mastacomys
SPECIES

Lichtenstein's rat Mastacomys lichtensteini

FAMILY 9

Mole Rats—Spalacidae

GENUS 1
Mole Rats—Spalax
SPECIES

Great mole rat Spalax typhlus

TABLE OF RODENTS

GENUS 2
Bamboo Rats—Rhizomys
SPECIES
Bay bamboo rat *Rhizomys badius*
Sumatran bamboo rat *R. sumatrensis*
Sze-chuen bamboo rat *R. vestitus*

GENUS 3
African Bamboo Rats—Tachyoryctes
FAMILY 10
Strand Moles—Bathyergidae
GENUS 1
Strand Mole—Bathyergus
SPECIES
Strand mole *Bathyergus maritimus*

GENUS 2
Georchus
SPECIES
Cape mole *Georchus capensis*

GENUS 3
Myoscalops
SPECIES

GENUS 4
Sand Rats—Heterocephalus
SPECIES
Abyssinian sand rat *Heterocephalus glaber*
Small sand rat *H. phillipsi*

FAMILY 11
Pocket Gophers—Geomyidae
GENUS 1
Pocket Gophers—Geomys
SPECIES
Common pocket gopher *Geomys bursarius*

GENUS 2
Thomomys
SPECIES
Northern pocket gopher .. *Thomomys talpoides*

FAMILY 12
Kangaroo Rats—Heteromyidae
GENUS 1
Dipodomys
SPECIES
Phillips's kangaroo rat .. *Dipodomys phillipsi*

GENUS 2
Perodipus
SPECIES
Agile kangaroo rat *Perodipus agilis*
Ord's kangaroo rat *P. ordi*

GENUS 3
Microdipodops
SPECIES
Microdipodops megacephalus

FAMILY 13
Pocket Mice—Heteromyidae
GENUS 1
Perognathus
SPECIES
Banded pocket mouse .. *Perognathus fasciatus*

GENUS 2
Heteromys
SPECIES

FAMILY 14
Jumping Hares—Pedetidae
GENUS
Jumping Hares—Pedetes
SPECIES
Cape jumping hare, or spring-haas. *Pedetes caffer*
Eastern jumping hare *P. surdaster*

FAMILY 15
Octodont Tribe—Octodontidae
GENUS 1
Gundi—Ctenodactylus
SPECIES
Gundi *Ctenodactylus gundi*

GENUS 2
Pectinator
SPECIES
Speke's gundi *Pectinator spekei*

GENUS 3
Petromys
SPECIES
Petromys typicus

GENUS 4
Massoutiera
SPECIES
Massoutiera mzabi
..... *M. va*

GENUS 5
Octodon
SPECIES
Degu *Octodon degus*

GENUS 6
Soft-furred Degus—Habrocoma
SPECIES
Bennett's degu *Habrocoma bennetti*
Cuvier's degu *H. cuvieri*

GENUS 7
Aconæmys
SPECIES
Aconæmys fuscus

GENUS 8
Tucotucos—Ctenomys
SPECIES
Tucotuco *Ctenomys magellanicus*

GENUS 9
Cururos—Spalacopus
SPECIES
Cururo *Spalacopus poepigii*

GENUS 10
Coypu—Myocastor
SPECIES
Coypu *Myocastor coypus*

GENUS 11
Hutias—Capromys
SPECIES
Hutia couga *Capromys pilorides*
Hutia carabali *C. prehensilis*
Short-tailed hutia *C. brachyurus*
Ingraham's hutia *C. ingrahami*

GENUS 12
Procapromys
SPECIES
Procapromys geayi

GENUS 13
Cane Rats—Aulacodus
SPECIES
Cane-rat *Aulacodus swinderianus*

GENUS 14
Loncheres
SPECIES

GENUS 15
Echinomys
SPECIES

GENUS 16
Carteron
SPECIES
Carteron sulcoides

GENUS 17
Dactylomys
SPECIES
Dactylomys dactylinus
..... *D. peruanus*

FAMILY 16
American Porcupines—Erethizontidae
GENUS 1
American Porcupine—Erethizon
SPECIES
Canadian porcupine *Erethizon dorsatus*

GENUS 2
Tree Porcupines—Syntheres
SPECIES
Brazilian tree porcupine *Syntheres prehensilis*
Mexican tree porcupine *S. novæhispania*

GENUS 3
Chætomys
SPECIES
Thin-spined porcupine .. *Chætomys subspinosus*

FAMILY 17
Old World Porcupines—Hystricidae
GENUS 1
True Porcupines—Hystrix
SPECIES
European porcupine *Hystrix cristata*
Hair-nosed porcupine *H. leucura*
Bengal porcupine *H. bengalensis*
Hodgson's porcupine *H. longicaudata*
South African porcupine .. *H. africa-australis*
Malay porcupine *H. brachyura*
Javan porcupine *H. javanica*

GENUS 2
Thecurus
SPECIES
Sumatran porcupine *Thecurus sumatrae*

GENUS 3
Brush-tailed Porcupines—Atherura
SPECIES
African brush-tailed porcupine *Atherura africana*
Malay brush-tailed porcupine *A. macrura*

GENUS 4
Trichys
SPECIES
Bornean porcupine *Trichys guentheri*

FAMILY 18
Chinchilla Tribe—Chinchillidae
GENUS 1
Chinchillas—Chinchilla
SPECIES
Chinchilla *Chinchilla lanigera*
Short-tailed chinchilla *C. brevicaudata*

GENUS 2
Lagidium
SPECIES
Cuvier's chinchilla *Lagidium peruanum*
Pale-footed chinchilla *L. pallipes*

GENUS 3
Viscachas—Lagostomus
SPECIES
Viscacha *Lagostomus trichodactylus*

FAMILY 19
Aguti Tribe—Dasyproctidae
GENUS 1
Agutis—Dasyprocta
SPECIES
Aguti *Dasyprocta aguti*
Aguchi *D. cristata*

GENUS 2
Pacas—Cecoligenys
SPECIES
Paca *Cecoligenys paca*
Taczanowski's paca *C. taczanowskii*

FAMILY 20
Dinomys
SPECIES
Dinomys branicki

FAMILY 21
Cavy Tribe—Caviidae
GENUS 1
Cavies—Cavia
SPECIES
Restless cavy *Cavia porcellus*
Cutler's cavy *C. cutleri*
Bolivian cavy *C. boliviensis*
Rock cavy *C. rupestris*

GENUS 2
Mara's—Dolichotis
SPECIES
Mara *Dolichotis patagonica*
Lesser mara *D. salinicola*

GENUS 3
Carpincho—Hydrochoerus
SPECIES
Carpincho *Hydrochoerus capivara*

SUBORDER II
Double-toothed Rodents—Duplicidentata

FAMILY 1
Picas—Lagomys
SPECIES
European pica *Lagomys pusilla*
Siberian pica *L. alpina*
Himalayan pica *L. roylei*
Ladak pica *L. ladacensis*

FAMILY 2
Hares and Rabbits—Leporidae
GENUS
Hares and Rabbits—Lepus
SPECIES
Brown hare *Lepus europæus*
Blue, or mountain hare *L. timidus*
Polar hare *L. arcticus*
Prairie hare *L. campestris*
Varying hare *L. americanus*
Wood hare *L. floridanus*
Tapiti, or Brazilian hare *L. brasiliensis*
Nelson's hare *L. nelsoni*
Marsh hare *L. palustris*
Swamp hare *L. aquaticus*
Indian black-naped hare *L. nigricollis*
Common Indian hare *L. rufica datus*
Afghan hare *L. tibetanus*
Woolly hare *L. oiostolus*
Upland hare *L. hypsibius*
Egyptian hare *L. ægyptius*
Rock hare *L. saxatilis*
Cape hare *L. capensis*
Rabbit *L. caniculus*
Red-tailed rabbit *L. crassicaudatus*
Assam rabbit *Caprolagus hispidus*
Liu-kiu rabbit *C. furnessi*
Sumatran rabbit *Nesolagus netscheri*

SCALE-TAILED SQUIRRELS

AFRICA south of the Sahara is the home of several species of curious rodents commonly known as flying squirrels, but better termed scale-tailed squirrels, or as they are not really squirrels, simply scale-tails (family *Anomaluridae*). They take their name from the presence on the under side of the root of the tail of a number of horny scales, which are used in climbing. In all of them the skull differs from that of the squirrels in the absence of a bony projection from the frontal bone defining the hind border of the socket of the eye. There is, moreover, only one pair of premolar teeth in each jaw.

The most generalised member of the family is the flightless scale-tail (*Zenkerella insignis*) of West Africa, which has the appearance of a small grey squirrel, although furnished with scales on the tail. Others are provided with flying members very similar to those of the Asiatic flying squirrels, but supported in front by a rod of bony cartilage arising from the elbow, instead of from the wrist. Of the typical genus *Anomalurus*, in which the tail is of medium length, most of the species are confined to Western Africa, but one species

(*A. pusillus*) occurs in Equatoria, while another is found on the east coast near Zanzibar. The red scale-tailed squirrel (*A. fulgens*) from the Gabun, is one of the largest species, measuring 21 inches in length, of which a third is occupied by the tail; its colour is bright tawny

orange, with a white spot between the ears, and another on each side of the muzzle. On the other hand, in the pigmy African flying squirrel—the mboma of the natives—the length of the head and body is only 11 inches, and that of the tail 5½ inches; the colour of the upper parts being dark grizzled grey, while beneath it is yellowish white, with the tail uniform pale brown. A large species (*A. peli*) from Guinea is black, with the tail and edges of the flying membrane white.

The habits of these animals appear to be very similar to those of ordinary flying squirrels, but in climbing tree-stems, preparatory to taking their leaps, they use the scales at the root of the tail to aid in obtaining a hold on the bark.

A third genus is represented by a small West African species (*Idiurus zenkeri*) characterised by the excessive length of its sparsely haired tail, the body being not larger than that of a mouse.



FRASER'S SCALE-TAIL

THE SQUIRREL FAMILY

THE squirrel family (*Sciuridae*), which includes the flying squirrels of the Northern Hemisphere, the ordinary squirrels, marmots, and susliks, is distinguished from the scale-tailed squirrels by the absence of scales on the tail, and the presence of distinct bony (post-orbital) processes defining the hind border of the upper half of the socket of the eye. Moreover, when a parachute-like membrane is present, it is supported by a rod of cartilage arising from the wrist. The palate of the skull is broad, and there are generally two pairs of premolar teeth in the upper and one in the lower jaw; but the first pair of upper premolars is small, and may be shed or wanting. The molars have roots, and in the young state at least their crowns are surmounted by tubercles, although in the adult they often show deep wavy enamel folds, forming transverse plates extending partially across the crown.

The family has an almost world-wide distribution, and contains an enormous number of species, many of which are exceedingly difficult to classify. In order to make the relationships of the various groups as clear as possible, it has been considered advisable to give a short general sketch of the genera into which the family is divided by naturalists, and then to notice a few of the more important and most generally interesting groups or species.

In the typical subfamily *Sciurinae* the crowns of the molar teeth are more or less shortened, with their

cusps arranged either in longitudinal lines or forming four oblique ridges in the upper and three in the lower ones.

The first genus is represented by the large *Rhithrosciurus macrotis* of Borneo, with finely grooved incisors. *Heliosciurus* includes arboreal African squirrels, like *H. rufobachiatus*, allied in skull characters to the *Xerus* group, and typically with a large infra-orbital foramen. Of other African genera, *Funisciurus*, as exemplified by *F. pyrrhopus* and *F. pauli*, has soft fur and a longer skull than *Xerus*; *Paraxerus* being very similar externally, but with different cheek teeth. *Protoxerus*, *Epixerus*, and *Atlantoxerus*—of which the last, as represented by *A. getulus*, alone has spiny fur—come nearer to *Xerus*. The typical terrestrial African spiny squirrels, like *Xerus rutilus*, have the ears short, only two pairs of teats, flat spines mixed with the fur, an elongated skull with short post-orbital processes, and rather tall cheek teeth. *Geosciurus* has still taller teeth; and the allied African genus *Euxerus* is represented by *E. erythropus*. The striped palm squirrel typifies the Indo-Malay genus *Funambulus*, which resembles the *Xerus* group in skull characters, but has cheek teeth more like those of *Sciurus*.

Giant squirrels, forming the genus *Ratufa*, are characterised by their large size, bright, *Sciurus*-like colouring, very low cheek teeth, and a single pair of

SQUIRRELS

upper premolars. In the typical squirrels, *Sciurus*, which range over Europe, Asia, and America, with three species in Africa, the skull is short and broad, with large post-orbital processes; there are usually two pairs of upper premolars, the cheek teeth are rather tall, and there are four or six pairs of teats. Certain Indo-Chinese and Malay species, such as *D. rufigenis*, constitute the genus *Dremomys*, distinguished from *Sciurus* by the flattened frontal region of the skull and the pointed muzzle, and the Bornean *Lavia hosei* typifies a group allied to *Funambulus*. Another Bornean squirrel has been separated as *Glyphotes*, a species from South-Eastern Asia is known as *Tamias maclellandi*, and one from Tenasserim as *Menetes berdmorei*, while a Chinese squirrel is distinguished as *Sciurotamias*.

The striped ground squirrels, or chipmunks (*Tamias*) of the northern temperate zone are characterised by their large cheek pouches. These lead on to the susliks (*Spermophilus*, or *Citellus*), in which the incisors, like those of the following genera, are not compressed, as they are in the preceding group. Next come the prairie marmots (*Cynomys*), followed by the marmots (*Arctomys*).

The subfamily *Nannosciurinae* is represented by the pigmy squirrels, in which the molars are very short and dormouse-like; the typical Malay species (*Nannosciurus*) having $\frac{3}{4}$ premolars, while in the West African *Myosciurus minutus* these are reduced to $\frac{1}{4}$. The family is completed by the flying squirrels.

GROOVE-TOOTHED SQUIRRELS

According to the foregoing scheme, the first representative of the family is the Bornean groove-toothed squirrel (*Rhithosciurus macrotis*), the typical member of a small genus easily characterised by the presence of a number of vertical grooves on the front of the incisor teeth. Much larger than the common squirrel, this species has an enormous bushy tail, long tufted ears, and black and white bands along the flanks. The molar teeth are of a simpler type than in any other member of this family.

ABYSSINIAN SPINY SQUIRRELS

The Abyssinian spiny squirrel (*Xerus rutilus*) is of a uniform yellowish red colour, with distinct conchs to the ears, and in size comparable to the European squirrel, but rather larger. These squirrels may be commonly seen in rocky places in the neighbourhood of Annesley Bay, associating in parties of five or six individuals; they are entirely terrestrial, and take refuge either in holes dug by themselves or in clefts and crannies in the rocks. The lesser spiny squirrel (*Atlantoxerus getulus*) is a small striped species, recalling the Indian palm squirrel; it is a native of Morocco,

Algeria, and Tunis, and the only representative of its genus. Here also may be mentioned the South African ground squirrel (*Geosciurus capensis*), likewise the sole member of its genus, and characterised by the absence of ears and the small size of its cheek teeth.

PAUL'S SQUIRREL

Paul's squirrel (*Funisciurus pauli*), of which a couple of specimens are depicted in the coloured plate on page 420, is an East African species, and may be taken as a good example of its genus. It was first described by Dr. Matschie in 1894 on the evidence of a living specimen brought to Berlin from Tanga, in the Usambara district of German East Africa, by Count St. Paul Hilaire. The general colour of the soft fur of the upper parts is a mixture of black and light brown, with a tinge of greenish, while the face and limbs are brownish red; the under parts being greyish white, and the tail black, with white tips to the hairs.

PALM SQUIRREL

The well-known Indian palm squirrel (*Funambulus palmarum*), so commonly distributed in open districts throughout India and Ceylon, but unknown to the east of the Bay of Bengal, and never found in forests,

typifies an Indo-Malay genus of which some of the characters are noticed in the introductory sketch of the *Sciuridae*. The length of the head and body is from $5\frac{1}{2}$ to 6 inches, and that of the tail rather more. The general colour of the upper parts is some shade of brown, with three narrow whitish or slightly rufescent longitudinal stripes on the back, the under parts varying from white to grey.

This pretty little squirrel is one of the most familiar of Indian mammals, exhibiting scarcely any fear of man, and uttering its bird-like chirp in every Indian garden. It is commonly found in groves and on the rows of trees bordering the roads in most Indian stations, but exhibits no special predilection for palms. It generally feeds on the ground in the neighbourhood of trees, and when alarmed seeks refuge in their boughs by darting up the stems with astonishing rapidity.

Dogs newly imported invariably take to hunting palm squirrels, but usually give up the pursuit in a short time as utterly hopeless. These squirrels frequently take up their abode in the roofs of houses, and will freely enter the rooms. In addition to the usual food of its kindred, this species will also consume white ants and other insects. The young—two to four in a litter—are produced in a large, bulky nest of grass or wool, placed either in a tree or among the rafters of a house. Two species are recognised by naturalists.

GIANT SQUIRRELS

The Indian giant squirrel (*Ratufa indica*) takes its name from its large size, the length being not less than a foot to the root of the long and bushy tail. Some of the other characters of this group of squirrels, which are confined to the Indo-Malay countries, will be



INDIAN GIANT
SQUIRREL

found under the heading of the family *Sciuridæ*. The Indian species, which is characterised by its tufted ears, is not known to the east of the Bay of Bengal; other members of the group are the Malay giant squirrel (*R. bicolor*), ranging from the Eastern Himalaya to Borneo, the golden-backed giant squirrel (*R. caniceps*), remarkable on account of assuming a special breeding dress, although this is confined to one variety of the species, and the nearly allied Irawadi giant squirrel (*R. pygerythrus*), in which the length of the head and body is about 9 inches, and the ears have no tufts.

Pale buff phases or races of the Indian species are known.

TYPICAL SQUIRRELS

The European squirrel (*Sciurus vulgaris*), which is the typical representative not only of its genus, but of the whole family of *Sciuridæ*, has a distribution comprising almost the whole of Europe and a considerable portion of Northern Asia, but does not include Northern Africa. There is considerable local variation in the colour of squirrels in different parts of this area, and the British race differs markedly from the typical Swedish representative of the species, and presents pronounced seasonal changes of colour, which render its appearance in winter very different from that in summer.

In winter the British race of the squirrel (*S. v. leucurus*) is foxy-coloured, with long tufts of hair to the summits of the ears and the tail nearly the same colour as the body. In the spring, however, the long winter coat of the head and body is exchanged for a shorter summer dress, and the ears lose their tufts, but the hairs of the tail do not change, and consequently become dirty white, owing to the bleaching effects of light. This dirty white or cream-coloured tint of the tail in summer is characteristic of the British race, while even in winter the tail is much less red than in many Continental squirrels, being reddish brown.

The typical race of the species (*S. v. typicus*) inhabits Southern Norway and Sweden, and in summer has a brownish red coat very similar to that of the British race, but a red tail, which does not bleach when the hairs are old and worn. In winter this red coat is exchanged for one of greyish brown, with traces of the summer tint along the middle line of the back and on the limbs. In the German race (*S. v. rutilans*) the colour is bright red at all seasons, although there is a tinge of light smoky grey along the flanks in winter, while the tail is always bright rufous, though often rather darker than the body (page 471). There is, however, a brown phase of this race, and all Continental squirrels exhibit a more or less marked tendency towards melanism.

Passing over several other red or reddish races of the species inhabiting various parts of the Continent, mention may be made of the Grecian squirrel (*S. v. lilæus*), in which the tendency to blackness is almost,

if not quite, universal, the general colour being brown, passing into blackish on the hind half of the back and the outer sides of the limbs; and another black race (*S. v. italicus*) inhabits the Alps. Still more different are the squirrels of Northern Russia and Siberia (*S. v. argenteus* and *S. v. sibiricus*), in which the general colour of the winter coat is light grey, with the long ear-tufts black. In Northern Siberia there is a race of squirrel (*S. v. arcticus*) which regularly turns white in winter, the grey Siberian race being apparently an intermediate stage between the typical red squirrel and the white Siberian form.

The length of the squirrel, exclusive of the hairs at the end of the tail, is about 15½ inches, of which 7 inches are taken up by the tail.

Ireland and Japan respectively mark the western and eastern boundaries of the range of the species, while its extreme northern and southern limits are indicated respectively by Lapland and the north of Italy. In the south of the latter country, and likewise in the Caucasus and the Crimea, squirrels are unknown.

Like other members of the genus, the European squirrel is mainly diurnal and arboreal in its habits, seldom descending to the ground, and when aloft leaping from bough to bough with surprising agility. The extent of these flying leaps shows that the "flight" of the flying squirrels is merely an ultra-development of this mode of progression. The chief food of the squirrel consists of nuts, beech-mast, bark, buds, and young shoots of trees; but there is evidence that it is also not averse from a diet of birds' eggs and perhaps insects. In feeding, all squirrels sit up on their hind quarters, and hold their food to their mouths with the fore paws. The shells of nuts are pierced by the sharp front teeth,

and every fragment is removed before the kernel is consumed.

Stores of food are laid up for winter use, but instead of being deposited in a single place, they are hidden in several repositories. In England and the whole of its more northerly habitat, the squirrel partially hibernates during winter, but wakes up at intervals to feed when the weather is mild, and again retires to slumber. Probably in more southern regions it is active throughout the year, as are the species inhabiting the warmer parts of the globe.

Squirrels associate in pairs, apparently for life, and generally frequent the same tree or clump of trees from year to year. The nest, or "drey," in which the young are produced, is built either in the fork of a branch or in some hole of the stem of a tree, and composed of leaves, moss, and fibres, carefully intertwined. When placed in a fork, it so closely resembles



IRAWADI GIANT SQUIRREL

the boughs in colour that its detection from below is difficult. In England the blind and naked young are born in June, and are usually three or four in number. They remain with their parents till the following spring; and, if captured at a sufficiently early age, form docile and affectionate pets. The squirrel can swim well, and its flesh is said to be good eating.

STORIES OF SQUIRRELS

That squirrels are occasionally carnivorous and take young birds from the nest and devour them is generally known, but that they may cause serious damage among young game birds is realised by few, the destruction being usually attributed to stoats, weasels, and the like. A writer in the "Scotsman" newspaper for 1909 relates, however, that some years ago a gamekeeper in the north of England informed him that he had been losing every season for several years many young pheasants and part-ridges, and that the depredations had become intolerable. He suspected sparrow-hawks, notwithstanding the fact that not a single pair of these birds bred on the estate or within a circuit of ten miles; but the writer attributed the slaughter to squirrels, of which there were many in the neighbourhood.

The gamekeeper scouted the suggestion, but a few days afterwards a brood of fowls were moving about when a squirrel was seen stalking them from a branch of a tree not six yards off. When the chickens moved under the tree the squirrel ran down the bole on the off-side, seized one of them, and reascended the tree to a considerable height, where it leisurely ate its prey. It may be added that squirrels do immense damage among young plantations, especially fir-trees, by destroying the shoots; and in 1907 so great was the damage done to young plantations in various parts of the Highlands that the extermination of the squirrels was decreed the following year.

Squirrel fur, more especially of the grey phase, is extensively used for coats, linings, and trimmings, but of late years British imports have declined, the chief seat of the industry in this fur now being in Germany. The darker bluish grey skins are the most valued, most of these being obtained from Okhotsk by the Alaska Company.

The European squirrel dates from the deposition of the Norfolk "Forest-Bed," belonging to the earliest series of the Pleistocene period; but extinct species of the same or allied genera are found in formations of Tertiary age down to the Oligocene.

THE RED AND THE GREY SQUIRRELS

In North America the place of the European species is taken by the red squirrel, or chickari (*S. hudsonianus*), and the grey squirrel (*S. carolinensis*), the former frequenting forests of all kinds, while the latter is chiefly restricted to those composed of deciduous trees. Dr. C. H. Merriam, describing the habits of the red squirrel in the Adirondack Mountains, states that this species exhibits little fear of man, and is the least wary of all its tribe. It is on the alert from dawn to sunset, and sometimes, especially when there is a moon, continues its rambles throughout the night; while, whenever abroad, it enlivens the solitudes of the forests with its continual chattering.

"Though an expert climber, delighting in long leaps from bough to bough, which he executes with grace and precision, he spends far more time on the ground

than the other arboreal squirrels, sometimes even making his home in holes in the earth. Old logs, stumps, wood-piles, and brush-heaps are favourite places of resort, and by excavating burrows beneath he converts them into the securest of retreats. As might be inferred from the boreal distribution of this animal, he is the hardiest of our squirrels. Not only does he inhabit regions where the rigours of Arctic winter are keenly felt, but, refusing to hibernate, he remains active throughout the

continuance of excessive cold; when running upon the snow he often plunges down out of sight, tunnels a little distance, and, reappearing, shakes the snow from his head and body, whisks his tail, and skips along as lightly and with as much apparent pleasure as if returning from a bath in some rippling brook during the heat of a summer afternoon."

This squirrel is fond of a variety of fruits, and also sucks the eggs and kills the young of the smaller birds.

The young are generally born early in April, and usually include from four to six in a litter.

The red species is of small size, with a relatively short tail, and short tufts to the ears in winter, its usual colour being greyish, more or less mixed with yellowish or reddish above, and generally white below. It shows dusky markings on the back, and sometimes also on the under parts. Its geographical range comprises the northern half of North America.

The grey squirrel is a more southerly species, extending from the south of Canada to Mexico and Guatemala. In size it is superior to the red, and its tail is proportionately longer, while there are no ear-tufts. Its usual colour is whitish grey above, varied with tawny, and white below, the flanks being marked with a pale fulvous line. There are, however, numerous varieties, one of which is dark olive brown above and grey beneath. In habits this species seems to be more like the European squirrel, being extremely wary and alert, and partially hibernating during winter. It buries its stores of food just beneath the surface of the ground in various parts of the woods. In confinement these squirrels form charming little pets. There are several other well-defined representatives of the genus in North and Central America, and several others in the southern half of the same continent.

R. LYDEKKER

STORIES OF SQUIRRELS

The squirrel would be among the most popular of pets if it were better understood. The common practice is, however, to thrust the poor little thing into a tiny cage, to which is attached a revolving wheel, and expect the creature to be happy. As soon as the owner puts in his hand to pick up his pet, as likely as not he will get a sharp nip from the squirrel's powerful teeth, which will make the blood flow. Thereupon the squirrel gets a bad name for unreliability of temper, for fierceness of disposition, and the like. A squirrel should never be permanently caged. To so active a creature the ordinary squirrel-cage means a life of torture. The nip



GERMAN SQUIRRELS IN WINTER DRESS

which it gives, however, has nothing to do with the cage life. A squirrel needs handling with extreme care, for if it be squeezed or frightened it bites instinctively, as if to bite itself free from its retaining bonds. Fear and instinct, not temper, are the actuating forces. "I'd rather handle my ferrets any day," said one young naturalist, through the flesh of whose finger the teeth of a pet squirrel had been made to meet. A little more experience taught him that the squirrel may be handled with perfect safety, provided that it be treated with gentleness and not frightened.

The most interesting authority on tame squirrels is Mr. W. J. Stillman, who wrote a charming little monograph on the lives of two of these animals which he kept. "Billy" and "Hans," joint heroes of his story, made as charming pets as any man ever kept. "Billy," captured very young, took to its owner at once. It accustomed itself to making a resting-place by day in his coat-pocket; it would hide its nuts among his books and in his typewriter, and make its playground on his writing-table. At

night it slept under a fold of his counterpane. There was a code of signals between master and pet. The squirrel developed a sort of nodding language. If it wanted to be taken up, or to be fed, or to be given water, or to be put into his pocket, it nodded with sufficient significance for him to interpret each of its various signs. He rarely mistook one command for another. "Hans," the second squirrel, was a little older when caught than "Billy," and much more shy and rebellious. Given the free run of the room which "Billy" shared with its master, it diligently sought an open door with a view to escape. It was indifferent to the friendly advances of "Billy" for some time, but gradually it thawed into recognition of its fellow, and served the favourite in the capacity of nut-cracker.

"Billy," spoiled by his master, would not crack his own nuts, but, waiting until "Hans" had parted the shell, would calmly take the kernel from between his teeth. At first the other made a gentle resistance, but in the end seemed to think that no opposition must be offered to so winsome a little robber. Gradually "Hans" was induced to notice the human friend of "Billy," and would climb about him and his belongings, and go to sleep with "Billy" upon his bed. "Billy" perished after an illness which is pathetically described by Mr. Stillman, intelligent and affectionate to the last. "Hans" pined for his departed playmate, and fasted. Upon recovering his spirits, he seemed desirous of taking the place of "Billy" in his master's affections, and reproduced all the pretty little ways of his dead companion. The squirrel adopted the nodding language, and if this failed it would gently bite its master's fingers to impress a command or request upon him.

When offered its liberty, it ran about a little confusedly, then, for the first time, doubled back to its master, and climbed into his pocket, as the other squirrel had been wont to do. "Hans" survived "Billy" only six months, and, in the opinion of his master, never recovered from the loss of the other squirrel. Mr. Stillman's monograph should be studied, not only for its intrinsic charm, but for the warning which it affords against too liberal a diet for these hardy little creatures.



ENGLISH SQUIRREL

In places where squirrels run wild, systematic kindness will make them tame and companionable. A supply of food placed for nut-hatches drew a squirrel to a certain window. After a time, the visitor became accustomed to the sight of forms moving about in the room, and would sit in a basket on the window-sill taking his meal without the least alarm. Next, the window was opened and the nuts placed on a table in the room, and he followed. It became a regular thing, then, for the squirrel to scuttle up to the window and wait to be admitted. He would sit and nibble his nuts while the inmates of the house were at their meals. By and by he had followers, and though the first-comer was not unwilling to be accompanied to the house, he resented the intrusion of his fellows into the room, and a new adventurer, in the resultant scuffle, lost half an ear.

A remarkable theory is advanced in defence of the squirrel's habits of attacking birds' eggs. It is that the squirrel seeks them not as food—except he be desperately pressed for a meal—but because the birds whose nests are assailed attract attention by their chattering to the tree in which he, too, makes his home. This argument will scarcely satisfy us, however, when we remember that the squirrel in such circumstances would be more likely to remove itself than the cause of its alarm. Even undisturbed, so far as can be seen, the squirrel will frequently shift its nesting quarters, as if unwilling to run the risk of remaining too long in one place.

The migratory instinct takes a pronounced form, according to credible observers. When hunger or other cause impels them to seek a complete change of quarters, squirrels assemble in multitudes, and brave the same perils to which the lemming exposes itself. When a river checks their passage, the story runs, each member of the wandering family transforms some fragment of wood or bark into a raft, displays its large tail to the wind, by way of sail; and the little living flotilla,



GREY SQUIRREL

carried by the strength of the breeze, thus reaches the opposite bank. Regnard describes such a migration which he witnessed in Lapland, but adds that disaster overtakes many of the voyagers, capsizing great numbers of them.

The catastrophe, which often overwhelms 3,000 or 4,000 of the little vessels, brings an extraordinary influx of wealth to those Laplanders who find the remains on the shore. The navigating skill of the squirrel is not noted in the migration which Brehm describes—though it is supported by analogous testimony regarding the migration of another rodent.

Brehm's informant spoke of a migration of Siberian squirrels which matched the march of the lemmings. They streamed in dense masses through the town and neighbouring forest, using the streets as well as the hedges and the roofs of houses as pathways, filling every courtyard, thronging through windows and doors into the houses, and creating indescribable confusion. This procession is said to have lasted three whole days, from early morning till late at night, ceasing only when darkness settled down over the land. All travelled in the same direction, from south to north, and all crossed a torrential mountain river, but by swimming, not by

CHIPMUNKS

raft. At such a spot there would be no means of forming a fleet such as the other migrants already described found ready to their use.

E. A. B.

CHIPMUNKS

The ground squirrel of Siberia and certain portions of Eastern Europe, together with several closely allied North American species commonly known as chipmunks, constitute a group serving to connect the typical squirrels with the susliks. Having molar teeth of the same type, chipmunks are indeed so closely allied to typical squirrels that it has even been proposed to include them in the same genus. They differ, however, from squirrels in the possession of pouches inside the cheeks, and are further characterised by the sides, or the back and sides together, being marked by longitudinal white or greyish white stripes bordered by black bands.

The ears are of medium size or small, and are never tufted with long hair, while the tail is shorter than the head and body, flattened, and rather wide. The skull is generally like that of the true squirrels, but rather narrower and more slender, and the first pair of pre-molar teeth in the upper jaw is either absent or very minute.

The common American chipmunk (*Tamias striatus*), with a number of allied species or races, is distinguished by having two white stripes, each bordered with black, and a simple black stripe running down the middle of the back, and has also two white stripes, separated by a black one, above and below the eye.

It is about the size of the European squirrel, with which it also agrees approximately in the general ground colour of the fur. There is, however, great local variation in this respect, chipmunks from the southern portions of the range of the genus being lighter in colour than those from the north. The distribution of this group of species extends from Canada and Manitoba to Georgia and Western Missouri. The long-eared chipmunk (*T. macrotus*), from California, differs from the group typified by *T. striatus* in the much greater length of its ears.

On the other hand, the Siberian chipmunk (*T. asiaticus*) and certain allied North American species are distinguished by having four light-coloured and five black stripes on the body. The tail is also relatively longer. The Asiatic species ranges from the shores of the Sea of Okhotsk westwards over the whole of Northern Asia, extending in Russia as far as the River Dwina, and along the entire course of the Amur. A number of more or less closely related chipmunks are found in North America from Lake Superior and the neighbourhood of the Barren Grounds to New Mexico and Arizona, and extend from the Atlantic to the Pacific seaboard.

Chipmunks are among the commonest of North American rodents, and their habits are consequently thoroughly well known. As those of all of the species are probably nearly similar, the account given by Dr. C. H. Merriam of the habits of the common chipmunk will suffice for all. These rodents are migratory, and may be very abundant in a certain district in one year, while in the next comparatively few will be seen; their relative abundance being dependent upon the

supply of food. Chipmunks feed not only on nuts and beech-mast, but also on various kinds of corn and roots, and are partial to the larvæ of insects. When beech-mast is abundant in the Adirondack Mountains, it may be safely predicted that swarms of chipmunks will make their appearance in the autumn. In such seasons the forerunners arrive in September, while by October the woods are alive with these creatures.

"Finding an abundance of food," writes Dr. Merriam, "they immediately establish themselves for the winter, and begin at once to hoard up large stores. They are the least hardy of our squirrels, commonly going into winter quarters before the middle of November, and rarely appearing again in any numbers till the warm sun, in March or April, has caused plots of bare ground to show up between the snow-banks.

"Early thaws sometimes bring them out in February; and, after having once emerged, they often make little excursions over the snow during pleasant days, though the temperature may be several degrees below freezing. In running from tree to tree, even when not pursued, the length of their bound varies from twenty-five to thirty-four inches—a long leap for so small an animal."

They commonly leave the Adirondack region in July, since it is but seldom that there is a good crop of beech-mast in two successive years. The young are born in the spring, and leave the nest by June.

Chipmunks collect an astonishing quantity of food for the winter, which is carried to the place of deposit in their capacious cheek pouches. In addition to regular storehouses, these rodents lay up a portion of their winter supply here and there beneath the leaves of the forest. In a hole tenanted by four chipmunks, the nest has been found to contain about a gill of corn, and in the communicating galleries upwards of a quart of nuts, a peck of acorns,



CHIPMUNKS

about two quarts of buckwheat, and a small quantity of maize and grass seeds. Generally the chipmunk keeps to the ground, although it will often run some few feet up the trunk of a tree, and when pursued, if its hole be not accessible, will take refuge among the branches. Instances are, however, on record where these animals have been observed regularly ascending tall trees in search of food; and they seemed perfectly at home among the boughs, although they never leapt from branch to branch after the manner of the true squirrels.

In regard to its general mode of life, Dr. Merriam observes that "the chipmunk establishes his head quarters in some log or stump, or in a hole excavated by himself in the earth, generally among the roots of a tree. He is partial to brush-heaps, wood piles, stone walls, rail fences, accumulations of old rubbish, and other places that afford him a pretty certain escape, and at the same time enable him to see what is transpiring outside. For, though by no means wary, he delights in these loosely sheltered hiding-places, where he can whisk in and out at will, peep unobserved at passers-by, and dart back when prudence demands. If suddenly surprised, he utters a sharp *chip-per-r-r-r*, and makes a sudden quick dash for his retreat, which is no sooner reached than, simultaneously with the disappearance of his tail, out pops his head, his keen

dark eyes gazing intently at the source of alarm. If not pursued farther, he is very apt to advance towards the supposed enemy, betraying his excitement by a series of nervous starts and precipitous retreats, till finally, making a bold rush, he dashes by the object of his dread, and in another instant is peering out from a hole beneath the roots of a neighbouring tree."

The chipmunk does not make an agreeable pet, as it is apt to be sulky and morose, and disposed to bite the fingers of anyone who offers it food.

SUSLIKS, OR GOPHERS

The suslik, or sisel, of North-Eastern Europe and Northern Asia and the striped gopher of North America are the best-known representatives of this genus of the squirrel family. Both in this and the two following genera the incisor teeth are not compressed, while the form of the body is stout, and the tail either short or of moderate length; the cheek teeth being of a simple type. The whole of the species are confined to Europe, Asia Minor, Asia north of the southern flanks of the Himalaya, and North America.

The susliks, as the members of the genus *Spermophilus* may be collectively termed, are characterised by their somewhat slender and squirrel-like form and large cheek pouches. The external ears may be very small, or comparatively large and tufted, and the tail varies from a mere stump to 8 or 9 inches in length. In the fore feet the first toe is rudimentary, but its nail is sometimes present. The skull approximates to that of the squirrels, but the first upper premolar is relatively larger, and the two rows of upper cheek teeth are nearly parallel to one another. The colouring may be either uniform or striped, but never resembles that of the chipmunks.

Susliks are mainly confined to the colder regions of the Northern Hemisphere, and have very nearly the same distribution as chipmunks. With the exception of Eversmann's suslik (*S. eversmanni*) of North-Eastern Asia, all the Old World species have short tails, while those of the New World are nearly all long-tailed, and approach more closely in form to the chipmunks. In North America no representatives of the genus occur to the east of the plains and prairies forming the centre of the continent, but they range westwards to the coast of the Pacific. In latitude the range extends from the shores of the Arctic Sea to the plains of Northern Mexico.

The European suslik (*S. citellus*) is abundant in Central and Eastern Europe and Siberia, and is a uniformly coloured rodent, scarcely as large as the European squirrel, with a very short tail and minute external ears. In America the commonest representative of the genus is the striped gopher (*S. tridecemlineatus*), which is some 7 or 8 inches in length, with a tail of about two-thirds that length and small ears. In colour it is typically dark reddish brown above, with six to eight longitudinal light stripes, alternating with from five to seven rows of light spots; the under parts being yellowish brown in the middle line, bordered on the sides with yellowish, with a narrow black band running between the two tints. This group ranges from the Red River in Canada to Texas.

In the long-eared gopher (*S. grammurus*), ranging from Colorado to California, the ears are very large, and often fringed with long hairs, while the tail is very long and bushy. Fossil remains show that susliks were more widely distributed in Europe during the Pleistocene period than at the present day, some of their remains having been discovered in the brick-earths of the Thames valley.

All susliks are social and burrowing animals, selecting open plains with a sandy or clayey soil for the construction of their domiciles, and studiously avoiding forests or swampy districts. The burrows of the European species are from six to eight feet in depth, and have each a single entrance. When, however, these animals retire to the depths of their burrows for their winter sleep, they excavate a second passage from the sleeping-chamber to within a short distance of the surface of the ground. On awakening in the spring, an exit is made through this second passage, and the original entrance blocked up, and the length of

time that a burrow has been occupied is thus indicated by the number of these deserted entrances. Within the burrow a large quantity of food, such as roots, seeds, and berries, is accumulated in the summer and autumn for winter use. Susliks will also eat mice and small birds and their eggs. The young are born in the



THE EUROPEAN SUSLIK

spring, and comprise from four to eight in a litter. If captured sufficiently young, susliks can be easily tamed; their flesh is much esteemed by the peasants of North-Eastern Europe and Siberia.

In America all the more northern species pass the colder portion of the year in a state of hibernation, but in the central portion of their range the period of sleep is considerably shortened, while in the extreme south the species remain more or less active throughout the winter. The striped gopher is more decidedly carnivorous in its habits than is the European suslik, devouring not only field and other mice, but also some of the smaller species of squirrels, which cannot even live in a district abounding with gophers. This gopher also frequently robs hens' nests, while other species have been detected in carrying off young chickens and turkeys. More remarkable is the fact that Richardson's gopher (*S. richardsoni*) was formerly in the habit of feeding on the flesh of the innumerable carcasses of bison left by hunters on the prairies.

Writing on the habits of Parry's suslik (*S. empetra*), from the neighbourhood of Hudson Bay and Bering Strait—a species closely allied to Eversmann's suslik of Siberia—Sir John Richardson observed that "it is found generally in stony districts, but seems to delight chiefly in sandy hillocks amongst rocks, where burrows, inhabited by different individuals, may be often observed crowded together. One of the society is generally observed sitting erect on the summit of the hillock, whilst the others are feeding in the

MARMOTS

neighbourhood. Upon the approach of danger, he gives the alarm, and they instantly betake themselves to their holes, remaining chattering, however, at the entrances, until the advance of the enemy obliges them to retire to the bottom." A so-called suslik from Turkestan has been referred to the genus typified by the prairie marmots.

PRAIRIE MARMOTS

In addition to being the home of several species of marmots akin to those of the Old World, North America also possesses a closely allied but somewhat more specialised genus (*Cynomys*) of rodents, the members of which may be designated prairie marmots, although they are often most inappropriately termed prairie dogs, while they are likewise known as barking squirrels (page 130). In size these rodents hold a position intermediate between susliks and marmots. They have small ears and generally short tails, while their cheek pouches are much less capacious than those of susliks. In their fore feet the first toe is well developed and furnished with a claw nearly as large as that of the fifth. The skull is massive, with the large post-orbital processes directed nearly outwards, and the teeth are very stout, with three grooves on their grinding surfaces in place of the two characterising those of the other two genera of the group. A further peculiarity in connection with the upper cheek teeth is that the two series, in place of running nearly parallel, are convergent behind.

There are several species of prairie marmots, two of which are confined to the prairies of the Rocky Mountain plateau, while a third inhabits Mexico. The common prairie marmot (*Cynomys ludovicianus*) is confined to the drier districts to the east of the Rocky Mountains, and is entirely an inhabitant of open plains.

The length of the head and body usually varies from $11\frac{1}{2}$ to $12\frac{1}{2}$ inches, and that of the tail, inclusive of the hairs at the tip, from 4 to 5 inches. In colour the upper parts are reddish brown, varied with grey, and the under parts yellowish or brownish white, the tail being coloured like the back, but with a brownish black tip.

The Columbian prairie marmot (*C. columbianus*) is a smaller species, distinguished by its much shorter tail, which is entirely white, and by the

more yellow tinge of the fur of the body. It occurs in the regions to the west of the Rocky Mountains, ranging at irregular intervals from Columbia through Colorado and Arizona to the Sierra Nevada, and is a more mountain-dwelling animal than the preceding, occurring as high as ten thousand feet above the sea.

The Mexican prairie marmot (*C. mexicanus*) is larger than either of the above, and distinguished from the common species of the plains by its much longer tail, in which the black at the tip is darker and extends for a greater distance.

In general habits prairie marmots very closely resemble true marmots; but it is stated that there is a distinct difference in this respect between the common

and the Columbian species, the burrow of the latter being unprotected by the raised funnel-shaped entrance which is so characteristic of the former. The following account of the habits of the Columbian prairie marmot is taken from the travels of Lewis and Clark, who write that "these animals form large companies, like those on the Missouri, occupying with their burrows sometimes two hundred acres of land. The burrows are separate, and each possesses perhaps ten or twelve of these inhabitants. There is a little mound in front of the hole, formed of the earth thrown up out of the burrow; and frequently there are three or four distinct holes



PRAIRIE MARMOT

forming one burrow, with their entrances around the base of these little mounds. These mounds, sometimes about two feet in height and four in diameter, are occupied as watch-towers by the inhabitants of these little communities. The marmots, one or more, are irregularly distributed on the tract they thus occupy, at the distance of ten, twenty, or sometimes from thirty to forty yards. When anyone approaches, they make a shrill whistling sound, somewhat re-

sembling 'tweet, tweet, tweet,' the signal for their party to take the alarm and to retire into their entrenchments. They feed on the roots of grasses, etc."

In Kansas the common prairie marmot only retires for a few days at a time during the most inclement portion of the winter, having been observed in January as active as in summer. Farther to the north, however, these animals retire to their burrows for longer periods.

MARMOTS

All who have travelled in the higher Alps or Himalaya are familiar with the shrill, piercing, whistle-like screams of the marmots, uttered when they first catch sight of an intruder on their lonely domains, and preparatory to taking refuge in the security of their burrows. Marmots (genus *Arctomys*), which are the largest members of the present group, are distinguished from prairie marmots by their still stouter build, the absence of pouches in the cheeks, and the rudimentary condition of the first toe of the fore foot, which has only a flattened nail in place of a claw. Their skulls are still broader, with the two rows of upper cheek teeth nearly parallel, and each tooth marked only by a pair of transverse grooves. The ears are small, like those of the prairie marmots, and the tail is short, although occasionally equal to half the length of the head and body. In size marmots vary from about 15 to 25 inches in length, exclusive of the tail; the measurements of the latter ranging from 3 to about 12 inches.

As regards general appearance, the stoutness of their bodies and the shortness of their limbs are their most obvious features. The head is wide and short, the small ears are more or less rounded, the eyes are large and full, and the tail is bushy. Their fur is of moderate length and rather coarse and stiff; and their colour is some shade of golden or reddish brown, passing more or less decidedly into black along the middle line of the back and on the tail, the tip of which is invariably dark.

In Europe there are two representatives of the genus, of which the first and larger is the Alpine marmot (*Arctomys marmotta*), now confined to the three disconnected mountain ranges of the Pyrenees, Alps, and Carpathians, although, as attested by its fossil remains, during the Pleistocene period, when the climate was different, it was an inhabitant of the lowlands of Germany and other parts of the Continent. The length of this marmot is about 20 inches, exclusive of the comparatively short tail.

The bobac (*A. bobac*) is a smaller species, measuring only about 15 inches from the nose to the root of the tail, and with a much wider geographical range. This species has its present westerly limits on the frontier of Germany, and thence ranges eastwards through Galicia and Poland across the steppes of Southern Russia, and in Asia at least as far as the Altai and Western Siberia; the climate of these regions being sufficiently cold to admit of the existence of marmots at low elevations. In Lapland and Scandinavia marmots are quite unknown, but the southern limits of the bobac do not yet appear to be ascertained. Allied species occur in Eastern Siberia and Kamchatka.

Central Asia and the higher ranges of the Himalaya are inhabited by numerous species of marmots, but the genus is unknown to the south of the latter range. Of these Asiatic species one of the best known is the short-tailed Himalayan marmot (*A. himalayanus*), which is nearly allied to the bobac, but of somewhat larger size. Its range extends from the mountains of Yarkand and other parts of Turkestan to Ladak and Eastern Tibet, where it is usually found at elevations of from twelve thousand to thirteen thousand feet.

The largest and handsomest of the whole Old World group is, however, the long-tailed red marmot (*A. caudatus*), in which the length of the head and body is about 24 inches, and that of the tail fully half that length. This marmot is readily recognised not only by its large size and the greater length of the tail, but also by the deep rufous tinge of the fur and the large amount of black in the region of the back. It may be met with on the mountain ranges to the north of the valley of Kashmir, and thence to Gilgit in one direction, and parts of Ladak in the other. Other kindred but smaller species are the Kabul marmot (*A. dichrous*) from Northern Afghanistan, and the golden marmot (*A. aureus*) from the mountains to the west of Yarkand.

The districts inhabited by all the marmots of the Old World are desolate and barren, being in most cases scorched with fierce heat in summer, while in winter they are subject to intense cold. In the Himalaya these animals are not met with until the traveller has crossed the wooded outer ranges and entered the bleak Tibetan districts. The occurrence of fossil remains of the Alpine marmot in many parts of Europe, such as Germany, the south of France, Italy as far south as Mentone, and Belgium, naturally leads to

the conclusion that Western Europe had at one time a more or less steppe-like climate. As milder and more genial climatic conditions supervened, the Alpine marmot gradually retreated to the nearest mountain ranges; and we thus have a complete explanation of its present isolated distributional areas.

The habits of all the marmots of the Old World are very similar; all the species of these rodents living in large colonies, and excavating burrows, in which they pass the whole of winter buried in profound slumber. Indeed, marmots seem to be the most thoroughly hibernating of mammals, since their sleep

is apparently unbroken, and they lay up no store of winter food.

All the species are diurnal in their habits, and their food is purely of a vegetable nature, consisting mainly of roots, leaves, and seeds of various plants. In the Himalaya the burrows are very generally constructed beneath the shelter of a plant of wild rhubarb; and the tenants on a fine day take up their station on the mound at the entrance, or journey for a short distance in search of food. At the least alarm they rush at once to the entrance of their burrow, where they sit up on their hind quarters to survey the scene and detect the

danger. If the enemy approach too close, the loud whistling scream is uttered, and the animal dives headlong into its burrow, to reappear after a time and see if the coast is clear.

Both in the Alps and Himalaya marmot warrens are situated in exposed situations, generally where there is a considerable open space, and which in winter are deeply buried in snow. In the case of the Alpine species, the winter quarters are made in large burrows, each with a single entrance, and terminating in an extensive chamber lined with grass; such chambers frequently contain as many as from ten to fifteen occupants during the winter, all lying closely packed together. From two to four young is the usual number in a litter of the Himalayan species.

Among the species of marmots inhabiting North America it will suffice to mention the woodchuck (*A. monax*), the Rocky Mountain marmot (*A. flaviventris*), and the hoary marmot (*A. pruinosus*). Of these the last is the largest, and agrees closely with the Alpine species, though the length of the head and body is said to reach from 23 to 25 inches. The second does not exceed 18½ inches in length of head and body, but has a much longer tail, of which the length is from 9 to 10 inches. This species, which ranges from California through the Rocky Mountains to about the 49th parallel of latitude, appears to be a strictly Alpine rodent, and is to some extent gregarious like the Old World species.

The woodchuck is the smallest of the three species, averaging only 14½ inches in length of head and body, with a tail of nearly half this dimension. It is generally mixed tawny, brownish black, and grey above, and yellowish or brownish red below: but some specimens



ALPINE MARMOTS

FLYING SQUIRRELS

are almost wholly black. The range of the woodchuck extends from Manitoba to Carolina, and westwards from the Atlantic to Missouri and Minnesota.

In habits this species differs considerably from the Old World forms. It delights in the open meadows and rocky hill-sides in the cultivated area round the Adirondack Mountains, where it feeds chiefly upon grass and clover. Although generally living in burrows of its own excavation, the woodchuck will sometimes take up its abode in rocky ledges or in the hollow roots of trees. During summer the greater number of these rodents live in the open fields; but in winter, in the Adirondack region at least, they retire to burrows situated close to, or actually within, the borders of woods. In the Adirondacks the woodchucks become very fat in the early autumn, and retire for their winter sleep—no matter what the temperature or the state of the weather—about the equinox, and do not awake till the middle or latter part of March. Still more remarkable is the circumstance that the animal often retires when the weather is genial and food abundant, while at the time of its re-appearance the ground is frequently deep in snow.

Like the Old World marmots, the woodchuck when much hunted becomes exceedingly wary and difficult to approach; but it differs from all the latter in that it will sometimes ascend trees and shrubs—making these ascents sometimes for pleasure and at other times to avoid foes. Woodchucks live either singly or in

pairs; the young, which are born at the end of April or beginning of May in the Adirondack district, remaining with their parents only a few months. The number in a litter is usually from four to six. When the young first leave their parents, they take refuge in stone walls, hollow logs, or even hollow trees—habits quite different from those of their Old World cousins, and showing a marked approximation towards chipmunks.

In some parts of New Hampshire woodchucks are so numerous as to cause serious inconvenience to agriculturists, and rewards have consequently been offered by the State for their destruction.

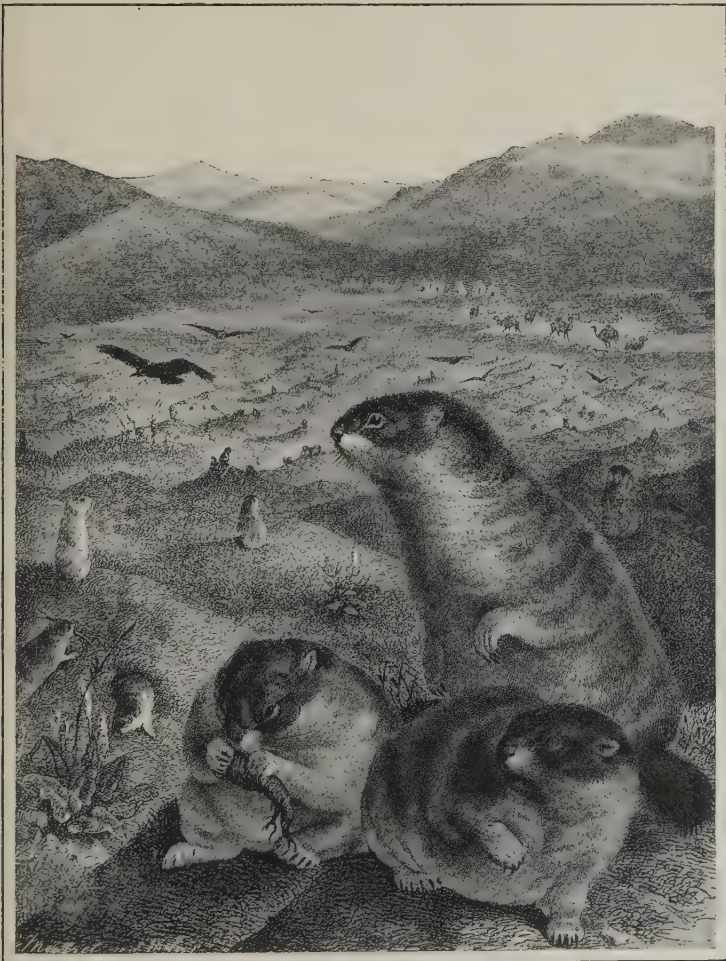
Remains of extinct species of susliks occur in the higher Tertiary rocks of Europe; in addition to which the Oligocene strata of France yield evidence of an extinct but apparently allied genus known as *Plesi-spermophilus*. More primitive are the forms described as *Plesiarcctomys*, which, while showing certain resemblances both to marmots and squirrels, have triangular three-cusped upper molar teeth, and no bony process defining the hinder limit of the upper border of the socket of the eye. These rodents are found in the Middle Tertiary deposits of Europe and North America.

FLYING SQUIRRELS

The flying squirrels of the Northern Hemisphere, which it will suffice to divide into three generic groups (*Sciuropterus*, *Pteromys*, and *Eupetaurus*), are amply characterised by possessing a parachute-like membrane extending from the sides of the body to the toes, and supported in front by a cartilage attached to the outer side of the wrist. There is also another membrane connecting the side of the neck with the fore limb, and there may be likewise one between the hind legs and the root of the tail. The cheek teeth are of a very complex type, and as their skulls differ considerably from those of all the preceding genera, the flying squirrels are regarded as indicating a distinct subfamily, *Pteromyinæ*. Moreover, as the group is of considerable antiquity, it is not improbable that it has no generic affinity with any of the foregoing genera, but that it traces its descent to some totally extinct group of the family.

Flying squirrels are widely distributed, ranging from North America to Japan, China, Tibet, Siberia, Eastern Europe, and the Indo-Malay region. They are all exclusively nocturnal in their habits, and mainly inhabit forest regions, although one may frequent rocks alone. Their mode of flight and habits are very similar to those of the flying lemur (page 332); and when leaping from tree to tree they utter sharp, piercing cries, familiar to all who have travelled in regions where flying squirrels are to be found.

The lesser flying squirrels, constituting the genus *Sciuropterus*, are those which have the lowest crowned molar teeth in the group, although there is considerable variation in the structure of these teeth. All the members of the genus are distinguished by the parachute-like membrane along the sides being of moderate width, and by the rudimentary condition of the membrane between the hind legs, which does not include any portion of the tail. The fur, as in the other members of the group, is very thick and soft, but the tail differs from that of other flying squirrels in being broad and flattened from above downwards, in order, probably, to act as an aid in flight. In size these animals



A COLONY OF BOBAC MARMOTS

vary from 5 to 12 inches in length. The large size of their expressive eyes and the beautiful silky softness of their fur render them exceedingly attractive creatures. The common North American species (*S. volucella*) has the fur ashy brown above and creamy white below.

The lesser flying squirrels include a considerable number of species, two or three of which are inhabitants of North America, while another is found in Siberia and North-Eastern Europe, all the others being confined to the Indo-Malay region, extending as far northwards as Afghanistan and Kashmir. The following notes refer mainly to the habits of the common North American species. Like ordinary squirrels, these rodents subsist mainly on nuts, seeds, and buds, but the American species also eats beetles, and probably other insects, and may be taken in traps baited with meat, while in confinement it will seldom refuse flesh. Flying squirrels construct nests in the hollow trees they haunt, and in the cold winters of the Adirondack region retire to these nests and probably hibernate. The same habits doubtless hold good for the species inhabiting Kashmir and Afghanistan, but those inhabiting India proper and the warm Malay region remain active at all seasons. The Kashmir flying squirrel (*S. fimbriatus*), in some cases at least, produces four young at a birth.

In the daytime these squirrels remain concealed in hollow trees, and only issue forth at sunset in quest of food. Numbers frequently associate in one tree, and if such a tree be discovered the creatures may be induced to come forth one after another by tapping the stem. With regard to the leaps of the common American flying squirrel, Dr. C. H. Merriam observes that "the ease, grace, and rapidity with which it glides from tree to tree inspire the merest passer-by with wonder and admiration. Its ordinary mode of progression is by a series of alternate climbs and leaps. Upon reaching a tree, the first act is to ascend, for, being unable to sail horizontally, it must attain a considerable elevation before venturing to leap to the next. Instead of moving off in this way when disturbed, it sometimes runs up into the topmost branches of the nearest tree, and, curling itself into a surprisingly small compass, remains motionless until the intruder has taken his departure." In North America flying squirrels breed in April.

The common American flying squirrel, if taken young enough, can be readily tamed, and forms a charming pet. Indeed, these graceful rodents become thoroughly confiding much sooner than any other kind of wild creature. When going to sleep, a specimen kept by Professor F. H. King was in the habit of first placing its nose upon the table, or other surface upon which it happened to be standing, and then walking forwards and at the same time rolling itself up, until the nose almost protruded from between the hind legs.

The tail was then curved in a horizontal coil around the feet, so that the whole animal appeared to form a complete ball of soft fur.

One of the smallest representatives of these rodents is the pigmy flying squirrel (*S. spadiceus*) of Arakan and Cochin China, in which the length of the head and body is only about 5 inches, while the tail is half an inch shorter. This species is chestnut red above, with the basal portions of the hairs black, and white beneath. The polatouche, or Siberian flying squirrel (*S. volans*), is about 6 inches in length, with the upper parts of the body in summer tawny brown, and the under parts pure white; the tail being greyish above and rufous beneath. Extinct representatives of these flying squirrels have been recognised from the middle Tertiary deposits of Europe, and it is probable that the genus is likewise represented in the corresponding rocks of North America.

The larger flying squirrels (*Pteromys*, or *Petaurista*), in addition to their superior dimensions, are distinguished from the preceding by the greater relative width of the flank membrane, by a well-developed membrane connecting the hind legs and embracing the upper part of the tail, as well as by the perfectly cylindrical form of the tail itself (page 472). They are further characterised by the taller crowns and more complex structure of their cheek teeth, which are nearly similar in all the species.

There are at least fifteen species of this genus, ranging from India, through Burma and the Malay region, to the south of China, Formosa, and Japan, and also extending northwards into Sze-chuen and Tibet. One of the best-known species is the Malay flying squirrel, or taguan (*P. petaurista*), from the Malay Peninsula and Islands. Closely allied is Hodgson's flying squirrel (*P. magnificus*), from the Nepal Himalaya

and the ranges south of the Assam Valley at elevations of from five thousand to six thousand feet. The length of the head and body of this species is 16 inches, and that of the tail from 18 to 22 inches.

Its colour appears to undergo a seasonal change, the upper parts, in what is considered to be the summer dress, being of a deep maroon colour, usually with a more or less distinct yellow line down the middle of the back, while the sides of the neck and the inner border of the parachute are yellowish, and the rest of the latter reddish or chestnut. On the other hand, in the presumed winter coat the upper

parts are chestnut, without any light colour down the back.

The larger forests of peninsular India south of the Ganges, as well as those of Ceylon, Burma, and Mergui, are tenanted by another very fine species known as the large brown flying squirrel (*P. ovalis*), in which the length of the head and body varies from 16 to 18 inches, and that of the tail from 24 to 25 inches. The general colour is grizzled brown above, varying from deep chestnut



THE AMERICAN LESSER FLYING SQUIRREL

HORNED RODENTS

to grey in one direction, and to black in the other; the under parts being white, often more or less tinged with grey or brown. In the Western Himalaya, at elevations of from six thousand to ten thousand feet, and in Kashmir this species is replaced by the closely allied large red flying squirrel (*P. inornatus*), distinguished by its more rufous fur. The spotted flying squirrel (*P. punctatus*) is a considerably smaller species from Malacca and Burma, distinguished by the white spots on the back. Handsomest of all is the Sze-chuen flying squirrel (*P. melanopterus*), in which the upper parts present a striking contrast of velvety black and rich chestnut.

The habits of all the members of this genus are very similar, and closely resemble those of the lesser flying squirrels. The large red species probably hibernates, but most of the others are active throughout the year. The common brown Indian form inhabits the forest, but in forest-clad districts it may be found near villages in clumps of mango and other trees. In addition to fruits and nuts, it is said to eat bark, and also insects and their larvæ; and it drinks by lapping with the tongue. Its cry is described as a low, soft monotone, quickly repeated.

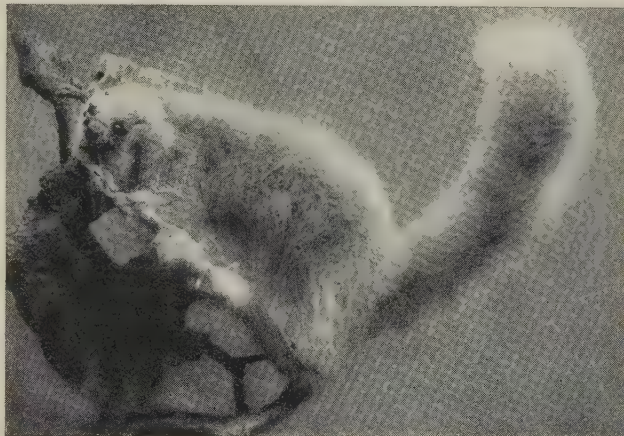
Dr. W. T. Blanford writes that this "flying squirrel sleeps during the day, sitting, like so many arboreal mammals, with its back bent into a circle and its head thrust inside; or, in hot weather, lying on its back with the parachute extended. It is not so active as other squirrels, either on trees or on the ground, the parachute impeding its movements. When passing from one tree to another at a distance, it leaps, with its parachute extended, from the higher branches, and descends, at first more directly, then, apparently, by availing itself of the resistance of the air, more and more obliquely, until its flight, gradually growing slower, becomes horizontal, and finally terminates in an ascent to the trunk or branch of the tree to which its course is directed." It is stated that these flying squirrels have been known to traverse distances of sixty and nearly eighty yards in their flight from tree to tree. Although readily tamed, they are very difficult to keep alive in captivity.

WOOLLY FLYING SQUIRREL

The woolly flying squirrel (*Eupetaurus cinereus*) differs from all the other members of the family in having markedly high-crowned teeth, with flat, instead of ridged, grinding surfaces, and is accordingly referred

to a distinct genus, which must be regarded as the most specialised member of the group. This magnificent flying squirrel inhabits the district of Gilgit, to the north-west of Kashmir, and is one of the largest species, the length of the head and body being about 18 inches, and that of the unusually bushy tail about 24 inches.

This species differs from the members of the preceding genus by its shorter and blunter claws; its colour being dull greyish brown, with a slight greenish tinge above and ashy brown below. From the nature of the districts in which it occurs, and also from the shortness and bluntness of its claws, it is inferred that this flying squirrel is in the habit of climbing about on rocks, instead of living on trees. It is considered to be not improbable that this species also occurs in Tibet.



THE JAPANESE FLYING SQUIRREL Photo A. S. Rudland

PIGMY SQUIRRELS

A small group of tiny squirrels comprising several species, three being from Borneo, Sumatra, the Malay Peninsula, and the neighbouring districts, the fourth an inhabitant of the Philippines, and a fifth West African, is regarded as constituting a separate subfamily, the *Nannosciurinae*, although they were formerly included among the true squirrels. Their skulls are remarkable for the elongated form of the region of the face, while the forehead is much broader than in any other

type, and the process defining the hind border of the socket of the eye so elongated as to cause the eye to be almost surrounded by bone. In the upper jaw there may be either one or two pairs of small premolar teeth, and the molars are much more complex than in any other squirrels, closely approaching those of dormice in structure; the upper molars having only three transverse plates, instead of the four characterising those of the other members of the family.

One of the prettiest representatives of the group is Whitehead's pigmy squirrel (*Nannosciurus whiteheadi*), from North Borneo, in which the head and body measure only about $3\frac{1}{4}$ inches in length, and the ears are surmounted by extraordinarily long tufts of black and white hairs, apparently more elongated than in any other squirrel. This little rodent, which is grizzled olive-grey in colour, may be commonly seen running up and down the trunks of the forest trees on Mount Kina Balu. All the other Asiatic species are included in the same genus, but the West African species, on account of the absence of the first pair of upper premolar teeth, has been made the type of a genus by itself, under the name *Myosciurus minutus*.

HORNED RODENTS

THE Tertiary rocks of North America have yielded remains of a group of rodents forming the family *Mylagaulidae*, some of which differ from all other members of the order by carrying horn-cores on the skull.

The place of the group is among the *Sciuromorpha*, but without close relationship to the other families, the nearest being the *Sciuridae*. The antorbital foramen is close to the zygomatic, instead of considerably anterior to it as in most modern rodents. The family distinctions from the *Sciuridae* are the great enlargement

of the fourth premolar in the lower jaw and of a corresponding tooth in the upper one, with the reduction and final disappearance of the teeth posterior to it, and the tendency to tall-crowned teeth with closed enamel islands. To these characters may be added the position of the long curved incisor of the lower jaw, which is situated within the coronoid process.

The type genus *Mylagaulus* was hornless, but well-developed horn-cores occur in *Ceratogaulus* and *Epigaulus*.

THE BEAVER TRIBE

FROM the large relative size of the animals themselves, coupled with their extraordinary constructive and destructive powers, an amount of interest invariably attaches to beavers which is not vouchsafed to other members of the order to which they belong. As is so frequently the case in analogous instances, the constructive abilities and engineering capacities of these animals—marvellous as they undoubtedly are—have, however, been greatly exaggerated in popular estimation and the creatures credited with performing tasks of which they are utterly incapable.

Beavers, of which there are two main species or races—one confined to Northern and Eastern Europe and parts of Western and Northern Asia, and the other to North America—are the only existing representatives of the family *Castoridae*, in which the skull is characterised by its massive form, the absence of postorbital processes defining the hind border of the eye sockets, and the rounding-off of the angle of the lower jaw. There is only one pair of premolars in each jaw, and the cheek teeth have no roots, and perfectly flat grinding surfaces, with re-entering folds of enamel. The two series of cheek teeth converge towards the front of the jaws, and the premolar in each jaw is larger than any of the molars.

As a genus, beavers are characterised by their stout and heavy bodily conformation, this being most marked in the hind quarters. The head is large and rounded, with short ears, and the tail of moderate length, much flattened, and covered with a naked, scaly skin. The limbs are short, with five sharp-clawed toes on both the fore and hind feet; all the toes of the hind feet being connected by webs extending to the roots of the claws. The portion of the muzzle surrounding the nostrils is naked, as are the soles of the feet, while the ears are scaly. Both the ears and the nostrils are capable of being closed. The fur is peculiarly thick and soft, its general colour being reddish brown above, and greyer beneath. There is, however, some amount of individual variation in this respect, beavers from northern regions inclining to be darker than those from the southern districts of the habitat of these animals. Occasionally pied or white beavers are met with.

Each molar tooth has three folds of enamel on one side, and one on the other; the three folds occurring on the outer side in those of the upper jaw, and on the inner side in the lower teeth. In size, the beaver is the largest of all the Old World rodents, its length being about 40 inches, of which 10 are taken up by the tail. The weight of the adult animal varies from about 45 to 50 lb., but may reach as much as 60 lb.

In a pied skin of a Canadian beaver, preserved in the British Museum, the fur of the belly is silvery white, with the tips of the short hairs very pale grey, but the under fur of the back, although nearly white at the roots, is dark grey. The long fur of the back, on the other hand, is mostly grey for the greater part of its length, but the tips of many of the hairs are of the normal rich chestnut, this tint becoming more pronounced on the nape of the neck, and forming a continuous patch just above the root of the tail. The fur looks, in fact, as though

the tips of the longer hairs had been dipped in red varnish.

Structurally, the beaver is peculiar on account of the presence of a complete double claw, or nail, on the second toe of the hind foot, this abnormal structure taking the form of one complete claw placed in advance of another, so that the two together constitute a most efficient scratching or combing instrument. That this double claw is used solely for the purpose of combing and cleansing the fur of its owner seems to be the opinion of all who have written about the life-history of the beaver, and although there does not appear to be any record that the supposition is based upon direct observation, it is probably true. Had it been to assist in digging, the additional claw would have been on the front instead of the hind feet; while further testimony in regard to its being a combing instrument is afforded by the fact that there are other rodents whose hind feet are specially modified for this purpose.

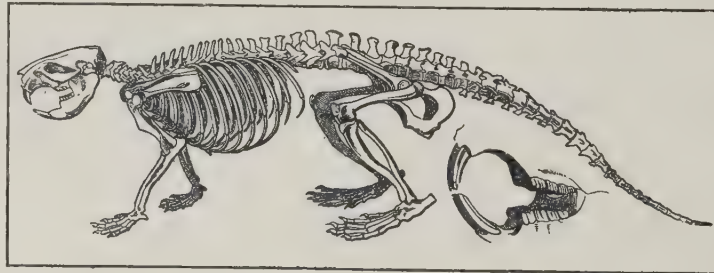
In South America, for instance, there are certain small burrowing rodents which take their technical name of *Ctenomys* from the fringe of long, stiff bristles on their hind toes, these bristles serving the purpose of a comb in cleansing the fur from the sand and dirt collected while burrowing. More remarkable still is the structure of the hind feet in three genera of North African burrowing rodents, of which the largest known is the gundi. In these creatures, as indicated by the names *Ctenodactylus* and *Pectinator* applied to two of the genera, each of the inner pair of toes of the four-toed kind is provided with a horny, comb-like structure and a number of stiff bristles, which are employed in dressing the soft fur. These instances seem to leave little doubt that the double claw on the second hind toe of the beaver is employed for a similar purpose.

It is, however, remarkable that the little Arctic burrowing rodent known as the banded lemming presents a claw structure almost exactly similar to that of the beaver's second hind toe, except that in this instance the peculiarity occurs in the fore foot, and includes the two middle toes, each of which has a complete double claw. In place of being permanent, these double claws are developed only in winter, when the creature changes its brown summer livery for a dress of white, and are believed to be for the purpose of aiding in the excavation of the winter burrow. If this be correct, it seems that while the double claws

of the banded lemming parallel the single one of the beaver in structure, they are developed on the front instead of the hind limb, are temporary in place of permanent, and have a totally different function.

At the present day naturalists mostly regard the American beaver (*C. canadensis*)

as a distinct species, which is, however, very closely allied to the typical European *Castor fiber*. The main difference between the two is to be found in the characters of the skull; that of the European beaver being relatively narrower in front, with the nasal bones extending somewhat farther back than is the case with its transatlantic cousin. A large series of specimens shows, however, that these characteristics are liable to a certain amount of variation in the two forms.



SKELETON AND JAWS OF A BEAVER

BEAVERS

A proposal has been made to divide European beavers into local races according to the river systems they inhabit; but some at least of the skull characters on which these supposed races have been named are merely due to immaturity.

Owing to incessant persecution for the sake of their valuable fur, both the European and the American beaver are probably doomed to extinction as wild animals; this fate having to a considerable extent already overtaken the European species, which only lingers on here and there in small numbers. Formerly, beavers were widely spread over Europe; and their abundance in the British Isles is attested not only by the numerous remains found in the fens and superficial deposits of England, but likewise by the number of places, such as Beaverbourne, Beverage, Beeverege, Bevercater, Beverley, Beverstone, and Beversbrook, which derive their names from these animals. That they occurred in the south of Scotland is proved by the occurrence of their remains, but there is no definite historical evidence of their existence, while in Ireland we have the testimony of neither remains nor documents.

On the Continent beavers are still met with in the Rhone and its affluents, where M. Mayet, writing in 1889, estimated that from twenty-five to thirty were annually killed. From 1885 till 1891 the conservators of the Rhone actually offered a bounty of 15 francs for every scalp of a beaver brought to their bureau, but this practice has been abolished, although further steps are urgently required in order to protect the species from extermination in the Rhone valley. The reason for the war waged against these rodents was an accusation that they burrowed into the raised banks of the river, and thus caused injury to the adjacent vineyards.

Beavers are now chiefly restricted to that portion of the Petit Rhone (the delta of Camargue) situated between Fourques and the Mas de Sauvage. This branch of the river is narrower and has a slower current than the main stream, and thus is much better suited to the habits of the beaver, which still has small colonies in this part.

In the Pleistocene period the beaver ranged into Italy as far south as Rome, but there is no evidence of its existence there since. In Poland and Lithuania a few still survive; but the last Lapland beaver was killed about 1830. In Scandinavia three considerable colonies exist near Arendal in Norway, the number living in 1883 being about one hundred: these colonies are strictly preserved. Apart from these districts beavers practically no longer exist in Europe.

In America the beaver once had a wider range than any other mammal save the puma, but now only a few colonies remain, more especially on the slopes of the Rockies, while in Canada its numbers have been so diminished that its extermination will be inevitable, unless it is rigidly protected.

Beavers are mainly nocturnal, and almost exclusively aquatic animals, although during summer they will sometimes make journeys of considerable

length on land, when they subsist upon fruit and corn, instead of their usual diet of bark and twigs. They are essentially social creatures, usually associating in larger or smaller colonies; although the few still remaining in the rivers of the Old World are—owing to the lack of companions—mostly solitary or in pairs. These rodents are expert divers and swimmers, their movements in the water being graceful and effected almost entirely by the aid of their powerful and webbed hind limbs. In addition to bark and twigs, they consume large quantities of the roots and stems of

water-lilies and other aquatic plants. The young, usually from three to four in a litter, are produced at the close of winter or early in spring, in the shelter of the burrow or lodge, but it does not appear to be ascertained whether they are born with their eyes open or closed.

Beavers do not hibernate in the strict sense of the term, although during the depth of winter they sleep longer and move about much less than at other times. In

winter, in America at all events, they swim about beneath the ice, dragging up water-lily roots for food and feasting upon the store of branches they have accumulated in the deep pools during summer; and it is for the purpose of securing a sufficient depth of water in which to swim beneath the ice that they construct their dams. Most of the beavers still remaining in the rivers of the Old World live in burrows in the banks, without constructing either dams or lodges. The colony near Magdeburg, however, is known to have undertaken both these engineering works, and it is thus probable that European beavers were originally similar as regards their habits to their American cousins, but that, through their reduced numbers and the constant persecution which they have undergone the building propensity has been lost.

In America beavers select as their haunts a well-timbered district traversed by a narrow stream; and by felling the trees on the banks, and forming with the aid of their trunks and boughs a dam and lodges across the stream, the water is headed back so as to form a large lake or pool (page 136). In some cases a series of such dams and pools may be seen one above another in the course of the stream. It is believed that the original object of tree-felling is to obtain a supply of food for winter; and that the employment of the peeled trunks and branches for the construction of the dam and lodges is a secondary development.

The beaver fells the trees by gnawing through the stems with its sharp front teeth at a short distance above the ground; the stem being generally gnawed nearly equally all round till the tree falls of its own weight. As trees on a river bank incline towards the water, they usually fall in the required direction. Sometimes, however, the animals miscalculate, and trees which they have felled may be seen caught in the forks of neighbouring stems. The trees selected for felling are from five to eight or nine inches in diameter, but trunks of as much as eighteen inches across are successfully attacked. The beaver goes to work in a thoroughly scientific manner, gnawing out very large chips, which



A BEAVER

HARMSWORTH NATURAL HISTORY

are sometimes as much as nine inches in length. When the trees are felled, they are stripped of their boughs, and the trunks cut into lengths of five or six feet, which, after being barked, are rolled into the stream or pond, and employed in the construction of the dam and lodges.

The term "lodge" is applied in America to the abodes constructed by these rodents in the water of their ponds. The lodge is nothing more than an extreme development of the burrow, or "wash," in the banks. On this subject Mr. Martin writes as follows: "Starting with the simple burrow, the next step is the accumulation of logs and branches about its entrance, forming what is called a 'bank-lodge.' In places where the water is shallow towards the shore, a great advantage would be derived from extending this artificial covering of brushwood, so that in time a natural evolution of the lodge disconnected entirely from the shore would take place, and form an independent and very convenient refuge from landward enemies." The lodge contains a large internal chamber, lined with grass, and is entered by several approaches beneath the surface of the water. The construc-

tion of the lodge is, however, of a much less elaborate nature than has often been stated to be the case.

Both dams and lodges are made more or less impervious to water by the addition of a quantity of mud, which is plastered on by the beavers with the aid of the fore feet, and not, as often supposed, with the assistance of the tail, which acts only as a rudder in swimming. The length of a beaver dam may be as much as one hundred and

fifty or two hundred yards, and the ponds may cover many acres. Frequently a formation of peat begins round the edges of the ponds, and this may extend over the whole area, converting it into a swampy tract known as a beaver meadow. A considerable part of the city of Montreal is built upon such beaver meadows.

In summer beavers forsake the neighbourhood of their lodges to travel up or down the stream; occasionally, as already mentioned, taking considerable journeys on land. With the advent of early autumn they return to their winter quarters, and at once set about the necessary repairs to the dam and lodges, and the collection of a supply of food for the winter.

An interesting account of the work done of late years by beavers in damming the Slate River on an extensive scale in Gunnison County, Colorado, has been written by Mr. E. R. Warren. In this district the Slate is a clear mountain stream, at an elevation of nearly 9,000 feet. Several dams and a few "lodges" have been in existence for some years, but in 1902 some very extensive new work was noticed farther down stream. So large was this work that, in order to arrive at an estimate of its extent and general effects on the valley, it was necessary to resort to surveying. With the exception of a couple of dams, all the recent work is on the south side of the river, the land on the north side having been raised above high-water mark and converted into a meadow—now covered with willows—by the labour of the beavers in past years.

"The lower dam is 76 feet in a straight line, but is curved twice, so that it is really larger; it does not quite reach the left bank, where there is a subsidiary oblique dam some distance down of about 20 feet in length. The effect of these two dams is to maintain deep water on the left side of the stream; and they head up the water for more than a couple of hundred feet, thus forming a pool which is in-

habited by a large colony of beavers. The second dam, which is about 350 feet from the first in a straight line, is nearly 100 feet long, and extends right across the stream, which flows over the north end. It heads up the water for a distance of nearly 500 feet. Some 200 feet above this dam is a large lodge, formed, in the usual manner, of mud and logs. Some 170 feet above this dam is a backwater, across which are two dams, one new and the other old, the former being about 20 feet in length by 8 feet in width, and mainly



BEAVERS FELLING TIMBER

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composed of mud. Other dams also occur in the neighbourhood."

All the dams are constructed of willow, although farther up stream the beavers have added spruce brought down from the mountains by avalanches. Mr. Warren found it difficult to assign an object for this damming of the stream, especially as there were only three lodges in the district; but it was suggested that the main idea was to afford a large extent of deep water in which the beavers might swim in safety beneath the ice in winter; but this does not explain the necessity for such a large flooded area, in which, with the exception of the ditches, there would not be much water of the required depth, although nearly all would be available for the numerous musk-rats of the district. Possibly the beavers had to work out the capacities of the valley by actual experience, and the shallow flooded areas are failures.

Formerly the great demand for beaver fur was for the manufacture of hats, but since the supersession of silk for beaver hair in this manufacture the fur has been used for more ordinary purposes. The incisor teeth of the beaver were used by the North American Indians, and also by some of the ancient inhabitants of the Old World, as cutting instruments, the base being fixed into a wooden handle with the aid of twine or thongs.

The great natural enemy of the beaver is the glutton, or wolverine, whose common Canadian name of carcajou is a corruption of the Indian word quickwahuy, said to

mean "beaver eater" (page 512). The glutton either digs the beavers out of their lodges, or catches them by lying in wait in the woods.

The Hudson Bay Company have assigned certain lands in their territory as beaver preserves, where a certain number of the animals are killed every third

year only. It has been proposed to establish "beaver ranches" in America, but the attempts to domesticate these animals do not hold out much encouragement as to the success of the project. It is true that beavers live and become fairly tame in menageries (where from their nocturnal habits they are rarely seen), but they rapidly deteriorate, losing the brilliant gloss of their coats, and acquiring dull, listless habits.

Remains of the European beaver make their first appearance in the Forest-Bed of the Norfolk coast, belonging to the lower part of the Pleistocene period, where they are accompanied by those of the giant extinct beaver (*Trogotherium*), distinguished not only by its superior size, but by differences in the structure of the skull and teeth. Its range extended to Siberia. Beavers belonging to the living genus occur

in the Pliocene strata of Europe and the Miocene of North America. The earliest European beaver is *Chalicomys*, remains of which are found in the Miocene beds of the Continent; this animal was of considerably smaller size than living beavers, while it differed from all existing rodents in having a perforation at the lower end of the upper arm bone or humerus.



A HAUNT OF BEAVERS, SHOWING THEIR WORK ON TREES

Photo C. Reid

THE SEWELLELS

CERTAIN peculiar North American rodents commonly known as sewellels (family *Haplodontidae*) differ so remarkably from all other living types that they are regarded as constituting a group apart from the Scuriromorpha. Compared with squirrels, to which they may be remotely related, the sewellels differ in the extremely flattened and broad skull, in which there is no postorbital process defining the hind part of the upper border of the socket of the eye. The molar teeth have no roots, and the first pair of premolars in the upper jaws is exceedingly minute.

The common sewellel (*Haplodon rufus*) measures about a foot in length, exclusive of the stump-like tail, which measures little more than an inch. The general colour of the fur is brown, more or less mingled with black, with the under parts greyish; the front teeth being yellow. The form of the animal is short and clumsy, with the body relatively large and cylindrical. Dr. Hart Merriam observes that "this singular animal, which has come down to us as a relic of the past, and has no near affinities with any existing group, inhabits a narrow strip of country on the north-west coast of the United States. All the specimens thus far obtained have come either from Oregon or Washington, or from the Chilukweyuk River near its junction with the Fraser, just

across our border in British Columbia." This sewellel lives in companies, and constructs burrows in moist ground.

The Californian sewellel (*H. major*)—the mountain beaver of the inhabitants—is a larger species, measuring 16 inches in length, with greyish brown fur above. These rodents inhabit the Sierra Nevada, and are largely aquatic in their habits. Mr. C. A. Allen, by whom the species was discovered, writes that they "live in small colonies, and inhabit wet ground where there is plenty of running water. They are very compact and strong, with a head which resembles that of a pug-dog. They are very shy, timid animals. On first seeing a human being they try to hide away, but on being aroused are savage enough. They come out of their burrows about sundown to get their food, and again at daylight in the morning."

The food of this sewellel is mainly composed of aquatic plants, especially the stems of a water-lily; and the burrows are always situated on the lower part of a hillside, and frequently have running water passing through them. The feet are eminently adapted for grasping, and it is stated that these rodents are in the constant habit of ascending broken and small trees furnished with branches. They are captured by means of traps set in the water.

THE DORMICE

THE rodents that now claim attention comprise several families more or less closely related to the rats and mice, and hence collectively termed the mouse-like group, or the Myomorpha. They differ from the squirrel-like group just described in the following points: In the first place the two bones of the lower leg—tibia and fibula—are united at their extremities. Secondly, in the slender zygomatic, or cheek, arch of the skull the cheek bone (jugal) seldom extends far forwards, and is usually supported from below by a long process from the upper jawbone (maxilla). None of them has any post-orbital processes in the skull marking the hind boundary of the upper part of the eye-sockets, and in no case is there more than a single pair of premolar teeth in each jaw, while even these may be wanting in either one or both jaws.

The elegant little rodents known as dormice, or sleepers, of the family *Gliridae*, or *Myoxidae*, so closely resemble diminutive squirrels in form and habits that they are commonly regarded as closely allied to that group. Apparently, however, these external resemblances are solely due to adaptation to a similar mode of life, the relationship of dormice to mice being much closer than to squirrels.

Dormice are confined to Europe, Asia—exclusive of the Indian and Malay countries—and Africa, and are all of small size and arboreal habits. They are characterised by their large ears and eyes, and long, thickly haired tails, the fore limbs being short in proportion to the hind ones. There is one pair of premolar teeth in both jaws, so that the total number of cheek teeth on each side is four, and these teeth are furnished with distinct roots, and have their crowns marked with transverse folds of enamel. The claws on the feet are short, and the first toe in the fore foot is rudimentary. All the members of the family are peculiar among rodents in lacking a cæcum, or blind appendage to the intestine.

COMMON DORMOUSE

The common dormouse (*Muscardinus avellanarius*) is the sole representative of the group inhabiting the British Isles, and the type of a distinct genus. This tiny little rodent, which is about equal in size to a mouse, is particularly characterised by the cylindrical form of the long and somewhat bushy tail; while internally it is distinguished from all its kindred by the complex structure of the anterior portion of the stomach. The cheek teeth have flattened grinding surfaces, with the folds of enamel arranged in a complex manner.

This dormouse has a rather large head, and a thick, compact body; the muzzle being somewhat pointed,

and the ears about a third the length of the head. The most striking feature of this rodent is, however, the large size and prominence of the full black eyes, which stand out in marked prominence to the tawny hue of the coat. In the adult the fur of the upper parts is light reddish tawny, while below it is paler and yellower, the throat and upper part of the chest being marked by a white patch. In the young, however, the colour is at first a mouse-grey, the reddish tinge of the adult

appearing first on the head and flanks, and thence spreading over the body. The length of the head and body is 3 inches, and that of the tail about half an inch less. White dormice are occasionally met with.

The dormouse appears to be confined to Europe, ranging from Sweden and Britain in the north to Northern Italy in the south, and extending eastwards as far as the north of Turkey, Galicia, Hungary, and Transylvania. Although more common in the southern

than in the northern districts of its habitat, it is reported to be less abundant in the south of France than either of the other species inhabiting Europe.

In its arboreal mode of life, and the manner in which it holds its food between its fore paws when eating, as well as in the nature of its food, there is much to remind us of the squirrel in the dormouse and its allies. But while squirrels are mainly diurnal, dormice are exclu-

sively nocturnal, remaining curled up during the day in their nests or in some hole asleep, and only issuing forth in search of food with the falling shades of evening. The dormouse is usually to be found in dense thickets and coppices, or in hedgerows, making its nest generally among the underwood, although sometimes beneath a protecting tussock of grass in the open field.

The winter nest is a globular structure composed of twigs, leaves, moss, and grass, and is built in the autumn, and stored with a small supply of food for winter use. Occasionally small colonies of either the breeding or the winter nests may be placed in the same thicket, as many as ten or twelve of these having been observed together. After feasting on the abundant nuts and mast of autumn, the dormouse accumulates a large amount of fat, and with the approach of winter retires to its nest for the period of hiberna-

tion. A warm day in winter, however, serves to arouse the little creature from its slumbers, when it will consume some of its store of food.

The chief food of the dormouse consists of hazel-nuts, acorns, beech-mast, corn, and haws and other wild berries. It is reported to extract the kernels from hazel-nuts without removing them from their stems, and in climbing from branch to branch in search of food



DORMICE



A WHITE DORMOUSE

SQUIRREL-TAILED DORMICE

exhibits marvellous agility. Both the fore and the hind feet are well padded internally with fleshy, broadish tubercles, thus converting them into hands, in the use of which the creature, when creeping about in a bush of whitethorn, exhibits an adroitness unequalled by the agile harvest mouse, and scarcely surpassed by the squirrel.

The duration of the winter sleep is from five to six months, dormice usually retiring about the middle of October, and not resuming activity before the end of March or April, by which time they have lost all traces of the fat accumulated in autumn. The young do not begin their hibernation so early in the autumn as the adults. In England the young of this species are born in the spring, although there is evidence that in some cases they may be produced as late as September, thus indicating the probability of there being two litters in a year. Brehm, however, states that on the Continent the young are not born till August. They are born blind and naked; the number in a litter being three or four. They are produced in a nest very similar to the one used for the winter sleep, which is always placed at a height of a yard or so above the ground. In Germany this species is known as the hazel mouse (*Haselmaus*).

SQUIRREL-TAILED DORMICE

Of the other European members of the family all differ from the common dormouse in the simple character of the stomach. Of the European species the largest is the squirrel-tailed dormouse (*Glis esculentus*), recognisable by its thick, bushy tail, in which the hairs are arranged in two rows. This species is further



SQUIRREL-TAILED
DORMOUSE



DORMOUSE FEEDING

characterised by the large size of its cheek teeth, in which the grinding surfaces of the crowns are flat and the foldings of the enamel complex. The length of the head and body is a little over 6 inches, and that of the tail rather less than 5 inches. The thick and

soft fur is ashy grey, more or less shaded with dark brown above, while on the under parts and the inner sides of the limbs it is silvery white; near the junction of the dark upper parts with the white of the under surface the colour becomes greyish brown.

The eyes are surrounded by dark rings, and the tip of the snout, as well as part of the throat, is white. The ears are of moderate size and rounded.

This species is found in Southern and Eastern Europe, extending from Spain, Greece, and Italy, through South and Central Germany, to Austria, Syria, and the south of Russia, but is unknown in Denmark and Scandinavia.

In habits this species closely resembles the common dormouse, but generally lies concealed during the day in the hollow of a tree, the cleft of a rock, or the burrow of another rodent; and its breeding nest is invariably concealed in some such situation, and is never built among the boughs of bushes as is that of the English dormouse. In autumn it becomes still fatter than the latter, and in this state it was much esteemed as a delicacy by the ancient Romans. The period of hibernation endures for upwards of seven months, these animals rarely coming forth before the latter part of April.

The young, which are sometimes born in the deserted nest of a starling, are from three to six in number; and although blind, naked, and helpless at birth, are remarkable for the rapidity with which they come to maturity. In addition to various nuts and berries, this dormouse consumes fruit, and is also said to devour small birds and other animals. In its turn it is preyed upon by martens, polecats, stoats, and wild cats. Like the common species, the squirrel-tailed dormouse is easily domesticated; and during its period of activity forms an attractive little pet.

THE TREE DORMOUSE

In Southern Russia, Hungary, Lower Austria, and Siberia there is another species of dormouse (*Glis*

nitedulus), allied to the last, but of considerably smaller size, although larger than the garden dormouse. It is generally reddish brown above and white beneath, including the lower surface of the tail, and easily recognised by the black line extending from near the nose through the eye to the root of the ear. The painted dormouse (*G. nitedulus pictus*) of Eastern Persia is a brighter-coloured race. Nearly allied is the Tirolese dormouse (*G. intermedius*).

GARDEN DORMICE

The garden dormouse (*Eliomys quercinus*) is the European representative of a group of several species distinguished from the preceding by the thinner and tufted tail, the larger and more pointed ears, and the characters of the cheek teeth. The latter are relatively small, and have their grinding surfaces concave, with the foldings of enamel very faintly marked. The group is represented in Africa as well as in Southern Europe.

The garden dormouse, known to the ancient Romans as the *nitela*, is smaller than the squirrel-tailed dormouse, although larger than the common species, the length of the head and body being at the most $5\frac{1}{2}$ inches, while the tail measures about $3\frac{3}{4}$ inches. The head and upper parts are greyish brown, with a more or less marked rufous tinge, and the under parts pure white. A black ring encircles the eye, and thence extends backwards as a streak beneath the ear to the neck, while there are dark and light spots behind and in front of the ears. The tail is greyish brown at the base, but at the tip black above and white below.

Mr. G. Billard has announced, as the result of experiment, that the garden dormouse is immune to the poison of the viper. Mr. Calmette has stated that he was acquainted with only three mammals immune to snake-bite—the pig, the hedgehog, and the mungoose. The alleged immunity of the last-named species was disputed by Dr. W. T. Blanford, who said that the mungoose escapes injury from cobras and other venomous serpents by its agility in avoiding their bites (page 429); but modern research appears to confirm native tradition as to the immunity of this animal.

Of a pair of garden dormice kept by Mr. Billard, the female was injected with enough viper venom to kill ten guineapigs; but half an hour afterwards seemed none the worse, and ate with gusto. After the male had been similarly treated it was killed, and its blood injected into a guineapig. The latter was then bitten by a viper without any ill effects ensuing. From these experiments it seems clear not only that the garden dormouse is immune against snake poison, but that its blood acts as a powerful anti-venom. During the period of its captivity the male had an eye pierced by the fang of one of the vipers, but, in spite of this injection of venom and numerous bites in various parts of its body, it remained unaffected.

The garden dormouse takes its name from being commonly found in the gardens and orchards of the warmer parts of the Continent, where it does much

damage to the choicer kinds of fruit. It is found in Central and Western Europe, including France, Belgium, Switzerland, Italy, Germany, Hungary, Galicia, and the Baltic provinces of Russia, and is specially common in the Harz Mountains. The species is more carnivorous in its tastes than any of its European kindred. The young may be produced in a deserted thrush's nest, or in some hole in a tree, or in a freely suspended nest; and it is characteristic of this species that whenever it builds a nest this is always placed between small boughs and never concealed.

AFRICAN DORMICE

Attention may be briefly directed to the Cape dormouse (*Graphiurus ocularis*), typifying a genus confined to Africa, the members of which are characterised by the hair being arranged uniformly on the tail, instead of in two longitudinal rows; the tail being of medium length, generally with a well-marked tuft at the tip. These African dormice are further characterised by the very small size of their cheek teeth, in which the foldings of enamel are nearly obsolete. The Cape dormouse is a large grey-coloured species, with black markings.

Remains of dormice are found not uncommonly in the Tertiary strata of Europe, as far down as the upper portion of the Eocene period, most of the species agreeing approximately in size with some of the living forms. The giant dormouse (*Leithia melitensis*), from the rock-fissures and cavern-deposits of Malta, is, however, now believed to be an ally of the squirrels.

INDIAN SPINY MOUSE

The pretty little Malabar spiny mouse (*Platacanthomys lasiurus*), from the hills of Southern India at elevations of about 2,000 feet, was long regarded as a member of the mouse tribe, in spite of its dormouse-like appearance and arboreal habits. It is now placed with the dormice, with which it agrees in the absence of a cæcum, or blind appendage to the intestine. It represents a sub-family characterised by the worn crowns of the cheek teeth showing oblique and nearly parallel bands of enamel, the long and thickly haired tail, and the presence of a number of broad, flat spines mingled with the hair of the upper parts. The ears are long and pointed, and the colour is reddish brown above and white below. The length of the head and body is $4\frac{1}{2}$ inches, and that of the tail 5 inches.

This curious mouse lives in large trees, excavating small hollows, in which it makes a nest of moss and leaves, and feeding, it is said, on jack-fruit and pepper-pods. *Typhlomys* is an allied genus from China.



THE GARDEN DORMOUSE

THE JUMPING MICE AND JERBOAS

THE rodents included in the family *Dipodidae* are terrestrial, and for the most part characterised by the great length of their hind limbs as compared with the front pair, and their long and generally hairy tails; their appearance and mode of progression being markedly kangaroo-like. They have very frequently four pairs of upper cheek teeth, and in all cases the incisor teeth are narrow, and the molars marked by transverse enamel-folds. The skull is characterised by the shortness of the brain case, and the very large size of the apertures in front of the eye sockets for the passage of the nerves supplying the face. There are also other distinctive features in the skull, more especially the large size of the hind part of the auditory bulla.

The jerboas and their allies are mainly Asiatic and African forms, although members of one genus occur in North America, and a few range into Southern Europe. Most of the jumping kinds are inhabitants of open and dry districts, such as grassy steppes or sandy deserts, and approximate in colour very closely to that of the ground on which they dwell. They form burrows in clayey or sandy soil, situated as a rule in open plains, but sometimes among thicker or thinner bush jungle. In habits they are mostly nocturnal, lying concealed in their burrows by day, and issuing forth to feed at night. Their nutriment consists of roots, berries, seeds, fruits, leaves, grass, and other herbage; but a few will also eat insects, small birds, and carrion. When feeding, they sit in a half-erect posture upon their hind quarters and tail; and convey the food to their mouth with the aid of their paws.

Their movements are peculiar, the body being supported on the hind limbs alone, perhaps aided at times by the tail. In walking, the legs are moved alternately in the ordinary manner, in which respect these animals differ from kangaroos, which always hop. Progression at a more rapid rate is always effected by a series of leaps from the hind legs; the length of such leaps being very great in proportion to the size of the animal. Like all desert-haunting animals, jerboas are extremely quick of hearing and long-sighted. Although generally silent, many of them have a kind of whining cry, which has been compared to that of a kitten. In the colder districts of their habitat, the species hibernate more or less completely; but they never lay up a store of provisions for winter use.

JUMPING MICE

The ordinary jumping mouse of North America (*Zapus hudsonianus*), the typical representative of the first subfamily is characterised by the presence of four pairs of rooted cheek teeth in each jaw, by the vertebrae of the neck being entirely separate from each other, and by the long hind limbs being furnished with

five complete toes, of which the metatarsal bones are separate. In the fore limbs the first toe is rudimentary, and furnished with a flat nail. Well-developed cheek pouches are present.

In appearance this rodent resembles a mouse with elongated hind limbs and a very long tail; the degree of elongation of the hind legs not being so great as in some other members of the family. The length of the head and body is a little more than 3 inches, and that of the tail about 5 inches, although there is a considerable amount of variation in the relative proportions of the latter. In the summer coat the fur is brown above, yellowish on the flanks, and white below, but in winter it is uniformly brown. The moderate-sized ears are black with light-coloured edges, and the long and nearly naked tail is tipped with a pencil of hairs.

In America the range of the jumping mice, of which there are several species, extends from the cold regions of the Great Slave Lake and Hudson Bay to Arizona and Mexico, although in the latter district they are restricted to the mountains. In British North America and the northern United States they range from the Atlantic to the Pacific coasts. One species (*Z. szechuanus*) inhabits the Sze-chuen province of North-Western China.

Jumping mice differ from most of their allies in not being strictly nocturnal, venturing forth early in the evening, and not infrequently being abroad during the day. They likewise frequent more wooded and damper situations. The following account of the habits of the common species was communicated to Dr. C. H. Merriam, who observes that, "The long-tailed jumping mouse inhabits high land or low land, forest or pasture, cultivated field or swamp, and appears to be equally at home in either, and not numerous in any situation.

It possesses a momentary agility second to no other rodent, and a muscular strength of enormous power for so small a creature. When suddenly disturbed, it often moves away in a direct line, the first three or four leaps being 8 or 10 feet in length, but these distances rapidly decline to about 4 feet. This is not always the case, however, for it frequently takes an irregular course and jumps at divers angles for several successive leaps,

keeping the same general direction, or changing at will. It can double, and quickly too, if pursued, and by its manœuvres and instantaneous squattings can elude a hawk or an owl, and its spontaneous irregularities enable it to escape being brained by a weasel or swallowed whole by the common black snake.

"This rodent feeds upon the buds, leaves, and twigs of many kinds of plants; upon seeds, grain, wild berries, chestnuts, acorns, grass, and to some extent upon the bark of shrubs. As a rule, three litters are produced in a season, each consisting of from two to four young.



KIRGHIZ JERBOAS

In leaping, the successive springs are made with such rapidity that the feet seem scarcely to touch the ground. The nest is placed in a variety of situations, sometimes in the hollow stump of a tree, more frequently under logs of timber, often in clefts of rocks, and occasionally a short distance from below the surface of the ground in an open field."

Jumping mice hibernate during winter in holes deep down in the ground; but the length of the sleep depends upon the latitude of the locality and the temperature of the season. In mild winters the hibernation is often interrupted for longer or shorter periods. The underground nest is carefully made of grass, in which the little animals lie tightly curled up, with the nose closely pressed to the belly and the long tail curled round the body, which assumes an almost ball-like form. So deep are the slumbers of these rodents, that they may be handled for a long time without evincing the slightest signs of life. The young of the various litters are to be met with from May till August. Fossil remains of jumping mice occur in the Pleistocene deposits of the United States.

FIVE-TOED JERBOAS

Jerboas, of which there are several genera, may be divided into two groups, according to the presence of five or three toes on the hind feet, and constitute the second subfamily, all the members of which are characterised by the cheek teeth, of which there may be either three or four pairs, having distinct roots; by the vertebrae of the neck being more or less completely united; and by the long metatarsal bones of the hind limbs being joined so as to form a cannon bone. In all cases only the three middle toes of the hind feet are of any functional importance, the lateral digits, when present, being small, and not reaching the ground.

The Kirghiz jerboa, or alagdaga (*Alactaga saliens*), is the best known representative of the genus to which it belongs, and one of the most characteristic mammals of the steppes of Central Asia. The genus *Alactaga*, in addition to the presence of five toes on the hind feet, is characterised by the long and tufted tail and large ears, and by the presence of a pair of premolar teeth in the upper, but none in the lower jaw, as well as by the smooth incisor teeth.

The alagdaga, as the animal is designated by the Mongols, is one of the largest members of the group, the length of the head and body being about 7 inches, and that of the tail considerably more. The colour of the fur is reddish yellow, with a tinge of grey on the under parts; while below, as well as on the inner side and lower parts of the hind legs, it is white, a white patch also occurring on the outer sides of the thighs. The tail is brown, with a black-and-white tip.

The range of this jerboa includes the whole of the steppe districts of Central Asia, and also extends into

Persia as far as Bushire, and into South-Eastern Europe as far as the Crimea and the region of the Don. During the Pleistocene period this jerboa inhabited parts of Germany.

Alagdagas are social animals, dwelling in small companies, and also selecting such portions of the steppes as possess a clayey soil for the construction of their large burrows. They are strictly nocturnal in habits, issuing from their burrows at the beginning of darkness, but not remaining abroad the whole night. Their speed is considerably greater than that of the true jerboas, and the length of their leap is enormous; indeed, it is stated that even when mounted on a swift horse it is impossible to overtake these creatures. The burrows constructed by the Kirghiz jerboa are very complicated, having several branches radiating from a central chamber; one of these branches always stopping a short distance below the surface of the ground, and being only used as an exit in time of danger, when the animal removes the barrier and escapes in an unsuspected direction. Usually two or three pairs occupy the same burrow.

In addition to a vegetable diet, the alagdaga also eats insects, and the eggs and young of the steppe lark, if not the old birds themselves. The young are born in summer, in a nest placed deep down in the burrow, and are from five to six in number, although there may be as many as eight in a litter. How long the young remain with their parents is unknown, although it is probable that they do not depart till the spring following their birth. In cold weather these rodents do not leave their nests, and the winter sleep is a long

one, enduring from the beginning of September till the latter part of April. The flesh of the alagdaga is eaten by the Kirghiz and other dwellers on the steppes; the capture being effected by surrounding the burrows with a fence and pouring water down the open holes, when the rodents seek to escape by breaking through the closed entrance.

The Afghan jerboa (*A. indica*) is a smaller species of the same genus, with proportionately longer ears and tail; the length of the head and body being about 3½ inches, and that of the tail, inclusive of the tuft at the end, 7½ inches. This species inhabits Afghanistan, the south-east of Persia, and Northern Baluchistan; and is found commonly on the plains of Quetta at an elevation of about six thousand feet.

In habits, this jerboa seems to be very similar to the larger species; its period of hibernation lasting from October till April. Central Asia is the home of other species of the genus, while yet others occur in Mesopotamia and Arabia. A very distinct species (*A. tetradactyla*) inhabits the Libyan desert between Alexandria and Suakin, and has only four toes on the hind foot. It is stated that the Afghan jerboa does not require water in the wild state, although it will drink in captivity



THE LONG-EARED JERBOA

TRUE JERBOAS

LONG-EARED JERBOA

The long-eared Yarkand jerboa (*Euchoretes naso*) is the sole representative of a distinct genus characterised by certain features in the skull, the great length of the nose, and the enormous size of the ears, which are longer than the head. The fur is sandy-coloured above and white below, the tufted tail being black near the end, but white at the extreme tip. The length of the head and body is $3\frac{1}{4}$ inches, and that of the tail $6\frac{1}{2}$ inches.

FLAT-TAILED JERBOA

An altogether peculiar species of jerboa inhabiting the desert regions of Central and Northern Asia is distinguished from the members of the two preceding genera by the flattened and lancet-shaped tail, in consequence of which it has received the name of *Platycercomys*. This species (*P. platurus*) is further distinguished by the absence of premolar teeth in both jaws. There appears to be nothing worthy of special notice in its habits.



EGYPTIAN JERBOAS

TRUE JERBOAS

The true jerboas, as typically represented by the common Egyptian species (*Dipus*, or *Jaculus*, *jaculus*), are the most specialised representatives of the sub-family, having completely lost the two small lateral toes on the hind limbs; while they are further distinguished by the presence of vertical grooves on the front of the incisor teeth, and also possess a pair of premolar teeth in each jaw. They resemble the alagadaga in the great length of the hind limbs and tail, and the comparatively large size of the ears, but the tuft of hair at the tip of the tail is smaller (pages 140 and 367).

In size the Egyptian jerboa is rather inferior to the alagadaga, the length of the head and body being about $6\frac{1}{4}$ inches; while the tail, exclusive of the hairs at the end, measures a little over 8 inches. The general colour of the upper parts is sandy grey, but the under surface of the body is white, and a broad white stripe extends down the hind limbs. The tail is yellowish brown above and whitish beneath, with the usual black and white tip.

The range of the Egyptian jerboa extends from the north of Arabia westwards through Lower Egypt to Oran in Algeria, but there are numerous other species of the genus, some of which inhabit Eastern Persia and Central Asia.

The name of two-legged mouse has been applied to the Egyptian jerboa on account of the fore legs being applied so closely to the chest when the animal is jumping that it has an almost bird-like appearance. The home of this species is arid and desert districts, where the ground consists solely of sand and pebbles, and the vegetation is so scanty that it is a marvel that even such tiny creatures can find the wherewithal to live. Here the jerboas live in companies, frequently of considerable size, in association with sand-grouse, the small desert lark, the cream-coloured courser, and various lizards. So exactly does the colour of the jerboa harmonise with its surroundings that at a short distance it is scarcely possible to recognise the

presence of a living creature. Although very abundant, it is, from its extreme shyness, seldom seen.

Like its kindred, this jerboa is essentially a nocturnal animal, but it comes out to feed before sundown, while it not infrequently sits at the mouth of its hole, or a short distance off, even in the full sunshine. It digs a burrow in the hard, gravelly soil with its fore feet, aided sometimes by its incisor teeth, these burrows generally having four entrances. The whole colony is said to take part in the construction of the burrows, and at the slightest sound the animals seek refuge in their retreats. When walking slowly, the jerboa moves one foot after the other, but directly the pace

is quickened it progresses by means of leaps, and so rapid are then its movements that travellers liken them to the flight of a bird. When leaping, the tail is carried stuck out nearly straight behind.

Jerboas are very impatient of rain and damp, and when such conditions are prevalent relapse into a kind

of torpid condition, analogous to the hibernation of species inhabiting more northern regions. The Arabs state that they form nests from their own fur within the labyrinths of their burrow, where from two to four young are produced at a birth.

The Arabs capture these tiny creatures by stopping up all the entrances to a burrow except one, where they place a net, and then digging down into the central chamber, when the jerboas are either caught in the nets or by the hands of their pursuers. Many are thus taken alive, while the flesh of those killed is eaten. The chief foes of the jerboa, next to men, are fennecs (page 367), caracals, and owls, by all of which large numbers are destroyed.

This jerboa, like its allies of Central Asia, is easily tamed, and from its beautiful form and delicate build, as well as its engaging manners, is always highly esteemed as a pet by its owners. In a wild state jerboas eat not only leaves, fruits, and seeds, but likewise insects and carrion.

SMINTHUS

Certain rat-like rodents—one (*Sminthus subtilis*) from Eastern and Northern Europe and Central Asia, a second (*S. concolor*) from North-Western China, and a third (*S. leathamii*) from Kashmir—are interesting as showing that the long hind limbs are not an essential attribute of the members of the present family. Indeed, the first-named of these rodents—for which there is, unfortunately, no English name—is so rat-like in appearance that it was long referred to the next family. It differs, however, from all the members of the latter by the presence of a pair of premolar teeth in the upper jaw, although there are none in the lower; while its skull agrees in essential features with that of the jerboas. The European sminthus has rather long and pointed ears, and a tail of nearly the same length as the body, clothed with short hairs. The premolar and last upper molar teeth are very small, and the whole of the cheek teeth have a complex pattern of enamel on their crowns.

THE MOUSE TRIBE

THE mouse family (*Muridae*), which includes mice, rats, hamsters, field mice, lemmings, and the like, is by far the most extensive group in the whole rodent order, having a cosmopolitan distribution, and being the only family represented in Australia. The majority of the mice—as the members of the group may be collectively termed—are of terrestrial habits, and have naked and scaly tails of varying length, while in most cases there is no great disproportion between the length of the fore and hind limbs. The incisor teeth are narrow, and, owing to the invariable absence of premolars, there are never more than three pairs of cheek teeth in each jaw.

In structure these teeth exhibit great variation in the different groups, being either furnished with roots, or rootless; while in some cases their crowns are capped with simple cusps, and in others with folds of enamel arranged in a series of angles. In all cases the first toe of the fore foot is rudimentary. The skull is the most characteristic part of their entire organisation. The frontal region between the eye sockets is much narrowed, and in the zygomatic, or cheek, arch, the cheek (jugal) bone is usually reduced to a mere splint occupying the middle of the arch. Again, the lower surface of the process arising from the upper jawbone to form the front half of the cheek arch is more or less flattened out into a nearly perpendicular plate; while the open space in the skull in the front of the eye sockets for the passage of the nerves of the face is generally of considerable height, and wider above than below. Only a few out of many genera and species can be mentioned.

AUSTRALASIAN RATS

The Australian water rat is the typical representative of a small group of genera constituting by themselves the subfamily *Hydromyinae*; most of the members of this group being restricted to Australia and New Guinea. The more typical members of this subfamily are distinguished from all other mice and rats by having only two pairs of molar teeth in each jaw, these teeth being rooted, and having their crowns divided into distinct lobes.

The Australian water rat (*Hydromys chrysogaster*) is a rat-like aquatic rodent, with broad and partially webbed feet, of which the webs and claws are larger in the hind than in the front limbs. The fur of the back is black, with a mixture of golden-coloured hairs; while the under parts are dark golden, save for a narrow stripe of flaxen running from the lower part of the neck to the middle of the belly. Except for its terminal fifth, which is flaxen-coloured, the tail is black. The tip of the muzzle is thickly covered with hairs, by means of which the nostrils can be closed. The length of the head and body is about 12 inches, and that of the tail 10 inches. The skull differs in the form of the

front portion of the cheek arch from the ordinary murine type. This species inhabits Australia and Tasmania, and is aquatic in habits, and not uncommon on the banks of rivers. The range of the genus includes New Guinea, where it is represented by *H. beccarii*.

The Queensland rat (*Xeromys myoides*) is a terrestrial species of about double the size of an ordinary mouse, which, while possessing teeth like those of the Australian water rat, has unwebbed toes and the external form and skull of a mouse.

The most specialised member of the group is the New Guinea water rat (*Crossomys moncktoni*), a black-and-white species, with very broad webbed and fringed fore and hind feet. It is the only representative of its genus. Another generic type is represented by Whitehead's rat (*Chrotomys whiteheadi*), from the mountains of Luzon, in the Philippines, which is also terrestrial in its habits.



AUSTRALIAN WATER RATS

Photo C. Grant-Lane

WHIP-TAILED GIANT RAT

The Philippine Islands are the habitat of the whip-tailed giant rat (*Phlaomys cumingi*), which differs so markedly from all others that it must be regarded as constituting a subfamily by itself. With the ordinary murine form, these rats resemble gerbils in having their cheek teeth divided into transverse vertical plates, of which there are three in the first tooth and two in each of the others.

The incisor teeth are very broad, with small front surfaces. The muzzle is unusually short, the profile is convex, and the ears are rather small; while the feet are characterised by their great breadth and the large size of their claws. The tail is shorter than the head and body, and sparsely haired. The hair is rather long and coarse, and darker on the muzzle, the sides of the face, the back of the head, the shoulders, and the fore part of the back than elsewhere. The length of the head and body is about 18 inches, and that of the tail 15 inches. Another subfamily is represented by the curious shrew-nosed rat (*Rhynchomys soricoides*), of the mountains of Luzon, which takes its name from its long and shrew-like muzzle.

GERBILS

The little Old World rodents known as gerbils are the typical representatives of another subfamily of the *Muridae*, and are recognised by their elongated hind limbs, long and hairy tails, and jerboa-like appearance and habits. From jerboas they differ externally in their longer muzzles, smaller eyes, and the presence of five functional toes to the hind feet. They are further distinguished by their cheek teeth being divided into transverse vertical plates, of which there are three in the first, two in the second, and one in the third tooth of each side. The upper incisor teeth are narrow and grooved, and the bullæ of the auditory region of the skull generally large.



HARES

"In fine weather hares are usually to be found in the open, but during rain they show a decided preference for covert, and while on some days they select the bare fallows, on others they repair to fields with long grass or other herbage."



INDIAN HUMPED CATTLE

“The voice of the humped cattle is more of a grunt than a low; and these animals differ from European cattle in habits, in that they seldom seek the shade, and never stand knee deep in water.”



EUROPEAN BISON

Although active both day and night, bison feed chiefly during the morning and evening. Large trees are stripped of their foliage and bark as high up as the animals can reach, while smaller ones are broken down or uprooted."



AMERICAN BISON

"The American bison differs from its European cousin not only in certain structural features, but in habits, being essentially an inhabitant of the open plains, where it formerly congregated in vast herds, comprising thousands of individuals, and living entirely on grass."

HAMSTERS

The true gerbils, of which there are a great number of species, inhabit Asia and Africa. By many naturalists they are split up into several genera, such as *Dipodillus*, *Meriones*, and *Psammomys*, the most distinct of these groups being *Pachyuromys*, which is characterised by the short and fleshy tail and narrow incisors. By some naturalists the name *Gerbillus* is discarded in favour of *Tatera*.

One of the best-known species is the Indian gerbil (*Gerbillus indicus*), which is about the size of a rat, with moderate-sized rounded ears, and the fur light brownish rufous above, and white beneath. With its large, bright eyes, and long, tufted tail, this gerbil, like its cousins, is one of the most graceful of the smaller rodents. In common with the other species, it inhabits open sandy plains, where it lives in companies, constructing extensive burrows approached by numerous passages, and having large central chambers containing dried grass. The Indian gerbil is a thoroughly nocturnal rodent, seldom leaving its burrow during the daytime. It is frequently found near cultivated grounds, where it does much damage to corn crops, sometimes appearing in such numbers as to constitute a veritable plague. Away from cultivated districts, its food consists mainly of grass and roots. It has been stated that gerbils lay up stores of food in their burrows, but it does not appear that this is really the case.

Gerbils resemble jerboas in progressing by a series of leaps on their long hind legs; the length of the leaps in the Indian species being from 12 to 15 feet. So active, indeed, are these little rodents, that they are generally able to elude such dogs as may pursue them, sometimes even jumping upon their backs. The Indian gerbil is one of the most prolific of rodents, frequently producing from twelve to fifteen young at a birth, and occasionally even more.

VELDT RATS AND TREE MICE

In this place mention may be made of two African genera of mice each typifying a subfamily by itself. The veldt rats, as represented by *Otomys bisulcatus*, are medium-sized species with the grooved incisors of the gerbils, but cheek teeth of quite a different structure. In the second group the South African tree mouse (*Dendromys mesomelas*), is one of several small mouse-like species which resemble dormice in their mode of life. Their form is light and slender, the incisors are grooved, and the long tail is sparsely haired and scaly; while the cheek teeth are somewhat intermediate between those of the hamsters and those of true rats and mice. *Deomys* is a second genus of African climbing mice, mainly distinguished by the characters of the cheek teeth.

HAMSTERS

With the exception of certain Malagasy species—which are referred by many naturalists to a family by themselves, the *Nesomyidae*—the hamsters, one Persian mouse, and the African *Mystromys*, all the true mice and

rats of the Old World are characterised by having three longitudinal rows of cusps on the crowns of their upper molar teeth. Their American cousins, the so-called "vesper mice," or white-footed mice, on the other hand, have only two such rows of cusps, and they are accordingly placed with the hamsters in a separate subfamily group, the *Cricetinae*, as distinct from the *Murinae*, or typical Old World mice and rats; the water rat and field mice, which have teeth of a somewhat more complex type, forming a third subfamily. The more typical Old World cricetines are characterised by their short tail, but in some of the American forms these appendages are very much longer.

Cricetines are distributed nearly all over the world except Australasia, and include the only representatives of the rodent order found in Madagascar, but there is only one African genus, the aforesaid *Mystromys*. In structure they appear to be the most generalised group of the entire murine family, and it is accordingly believed that they represent the ancestral stock from which came the more specialised rats and mice constituting the murine subfamily. This hypothesis is supported by the circumstance that the hamsters are some of the

oldest types of the family with which we are acquainted, remains of the nearly allied extinct genus *Cricetodon* being comparatively common in the Miocene strata of Europe.

The hamster (*Cricetus frumentarius*), of Europe and Northern Asia, is the typical representative of the cricetine group, and specially characterised by the fact that the incisor teeth are not marked by grooves, while the first upper molar tooth generally has six tubercles on its crown. Cheek pouches are present, the tail is very short, and there is a large gland on each side of the back,



EGYPTIAN GERBILS

the position of which is marked by a patch of fur coloured differently from the rest.

The common hamster is a decidedly handsomely coloured rodent, and by far the largest member of the group, measuring about a foot in length, of which some 2 inches are taken up by the tapering hairy tail. It is stoutly built, with a thick neck, a rather pointed muzzle, medium-sized membranous ears, large and brilliant eyes, short legs, and small claws. The thick, glossy coat is composed of hair and a woolly under fur. The general colour of the upper parts is usually light brownish yellow, but the upper surface of the snout and the region of the eyes, as well as a band round the throat, are reddish brown. There is a yellow gland-patch on the back, the mouth is whitish, and the under parts, the greater portion of the legs, and a stripe on the forehead are deep black, but the feet are white. There is, however, great variation with regard to colour, many examples being entirely black, while others are pied, and others, again, wholly white.

The hamster inhabits suitable localities from the Rhine to the Obi in Siberia, but its distribution is somewhat partial. In Germany it is wanting in the south and south-western districts, and also in East and West Prussia, but it is abundant in Thuringia and Saxony.

Its favourite haunts are soft, dry soils, but it avoids those of a sandy nature as being unsuitable for its burrows, although it will sometimes select gravelly ground.

The hamster has attracted a considerable amount of interest in consequence of the elaborate structure of its burrows and the provident nature of its habits. The burrow always comprises a large dwelling chamber, situated at a depth of from one to two yards below the surface of the ground, with a nearly perpendicular entrance passage and an oblique exit. There is also a store chamber or granary communicating with the dwelling chamber by means of a gallery; and it appears that the young, the females, and the males occupy distinct burrows, which may be distinguished by the size of their entrance passages, those of the males being the largest.

When a burrow is tenanted the passages are kept scrupulously clean, and the presence of any rubbish in them would at once proclaim that the habitation was deserted; chaff and straw may, however, be generally seen near the entrance of a burrow. Although the entrance passage goes nearly straight down into the earth, it always has a turn before opening into the dwelling chamber; and in old burrows the entrance and exit passages are polished smooth by the constant friction of the coats of their occupants.

The dwelling place is the smallest of the chambers, and has smooth walls and the floor strewn with fine straw, while there are three apertures—two communicating with the exterior, and the third with the granary. Young hamsters have only a single granary in their burrows, but the old males, which spend the whole summer collecting, frequently have from three to five such chambers. These are completely filled with corn, the passage communicating with the dwelling chamber being often stopped up with earth. All kinds of corn are equally acceptable to these industrious little rodents; and one part of the store chamber may be filled with grain of a particular kind, while the other portion may contain a different sort. In addition to corn, which forms their main winter nutriment, hamsters in summer eat peas, beans, roots, fruits, grass, and other green herbage, and in captivity will devour almost any kind of food offered to them.

Burrows of the nature described are constructed solely for winter use; and when the weather becomes cold in October the hamsters retire to their innermost recesses for their hibernation, the entrance and exit of each burrow being then closed with earth. In February or March these rodents awake from their slumbers, although they do not for some time open their burrows, where they remain feeding upon the stores of corn. About the middle of March the adult males make the first appearance abroad; and these are followed early in April by the females. At this time they devour ravenously almost anything that comes before them, not refusing an occasional young bird, a mouse, or a beetle. Soon afterwards they set about constructing their summer burrows, on the completion of which the sexes pair.

These summer burrows are of simpler construction than the winter habitations, being seldom more than

one or two feet in depth. Usually these burrows contain only a single chamber of about a foot in diameter. In the case of the females, the nest chamber has one exit passage, but from two to eight entrances, although until the young go afield, only one of the latter is used, the advantages of these numerous entrances when there is a large number of young being sufficiently obvious. The nest chamber is furnished with a bed of soft hay.

Towards the end of April the male visits the burrows

of the females, and if two should happen to meet in the same domicile, a fierce encounter ensues, the hamster, for its size, being an extremely ferocious and quarrelsome animal. In from four to five weeks after the pairing-time, the first litter of young is produced, the number of each litter varying from six to eighteen; and as a second equally numerous brood comes into the world in July, the rate of increase of these animals is exceedingly rapid. When newly



THE HAMSTER

born, the young, although furnished with teeth, are naked and blind. The hair, however, grows quickly, and by the eighth or ninth day the eyes are opened; while within a fortnight the young are able to burrow, and are soon afterwards driven away by their parents to shift for themselves. Although hamsters do not attain their full growth for a twelvemonth, it seems certain that a female born in May is capable of producing offspring in the ensuing autumn.

With these marvellously rapid powers of reproduction it is no wonder that hamsters frequently appear in countless swarms, when they inflict incalculable harm upon the harvest. Fortunately, they have a host of enemies, and buzzards, owls, ravens, and other predacious birds thin their ranks by hundreds; while among four-legged foes, polecats and stoats follow the track of the advancing legions, and kill them where and when they can. The polecat and stoat are, moreover, able to follow the hamsters into the recesses of their burrows, where they probably kill them by hundreds.

Man, too, joins the ranks of the destroyers of these mischievous rodents, and in some cases organises regular hunts for their destruction. In many districts the flesh of the hamster is eaten, and is said to be not unlike that of the squirrel. The fur, although not of high value, is extensively used for linings.

In Eastern Europe and Asia Minor there occur several smaller species of hamsters, in which the black of the under parts only occupies a small area of the chest; well-known examples of this group, which forms the subgenus *Mesocricetus*, being the Caucasian *C. nigriculus* and the Rumanian *C. newtoni*. Smaller still, in some cases not bigger than mice, are the pigmy, or sand, hamsters of the subgenus *Cricetulus*, such as the Grecian *C. atticus*, the Sze-chuen *C. obscurus*, and the Siberian *C. songarus*. Most of these sand hamsters are more or less uniformly grey rodents.

A fourth subgeneric group, *Urocrictus*, is formed by the long-tailed dwarf hamsters of Tibet and Sze-chuen, including *C. longicaudatus*, *C. camensis*, and *C. triton*. The species of *Cricetulus* are much more numerous.

FISH RATS

SOUTHERN CRICETINES

The white-tailed rat of South Africa (*Mystromys albicaudatus*) and the allied Central African *M. longicaudatus* represent a genus by themselves, and are the only members of the cricetine group in the African continent.

In Madagascar the place of the typical cricetines is taken by the allied group of the *Nesomyinae* (regarded by some naturalists as a distinct family), of which there are several genera, such as *Nesomys*, *Brachytarsomys*, *Hypogeomys*, and *Eliurus*. These Malagasy species show, however, few marked external features distinguishing them from ordinary rats and mice, and they must accordingly be passed over without further notice.

WHITE-FOOTED MICE

The New World possesses not a single indigenous representative of the true rats and mice of the Old World, all the American members of the family belonging either to the cricetine or to the closely-allied microtine subfamily, although the New World cricetines are often distinguished as *Sigmodontinae*. A considerable number of species belong to a group which may be conveniently designated white-footed mice, from the prevalence of white on their feet and under parts. These American mice, which have representatives from one end of the continent to the other, are now regarded as constituting a number of distinct genera, although they all possess molar teeth of essentially the same structure.

They exhibit great variation in regard to bodily form and the relative length of the tail, some groups having long tails and a dormouse-like appearance, other long-tailed forms being mouse-like, others again having short hamster-like tails and vole-like bodies while one species has spines mingled with the fur.

One of the best-known representatives of the group is the common white-footed mouse (*Peromyscus americanus*) of North America, which takes the place filled in Europe by the house mouse. It is, however, far more attractive in appearance, although of approximately the same size and configuration. In addition to its long tail, large ears, and bead-like eyes, this mouse is characterised by having the fur of the upper parts of the body of a rich fawn colour, which forms a striking contrast with the snowy white of the under parts and feet. Indeed, when we allow for the natural grace and agility of its movements, we have in this rodent one of the most beautiful and most interesting inhabitants of the forests of North America.

The common white-footed mouse is an inhabitant either of forests or open fields, and in the wild state feeds chiefly upon beech-mast, of which it accumulates large stores for winter use. It remains active throughout the winter, and may be seen running about on the snow, where its long tail leaves a characteristic track. It is an agile climber, running up tree stems with the activity of a squirrel, and frequently disappearing in some hole at a great distance above the ground. Besides nuts and seeds, the white-footed mouse will readily eat the flesh of such animals as comes in its way, and it is possible that it

may kill small birds for itself. From three to six young are produced at a birth, and there appear to be several litters during the year. The first coat of the young is of a uniform dull grey colour.

In the northern portions of the range of this mouse the nest is built either in the hollow of a tree or a log, or in a burrow; but more to the south these rodents construct an "outside nest" of moss, grass, leaves, or bark, which is more or less cocoa-nut-shaped, and may be as much as a foot in diameter. It is usually suspended from a horizontal branch at some distance from the ground, and has its entrance on the under surface. The genus to which this and a number of other species of white-footed mice belong is distinguished by having only five tubercles on the first molar tooth in the upper jaw. The rice-field mouse (*Oryzomys palustris*), which attains the size of a small rat, and does much damage to rice crops in the Southern States, is an example of another of the numerous genera, among which it will suffice to mention *Sigmodon*.

Here, however, reference must be made to a very interesting mouse from Persia, known as Bailward's mouse, a species very closely related to the North American *Peromyscus*, with which it agrees in having only five cusps on the first upper molar. It is a fawn-coloured species, with the under parts white, the ears long, and the tail tufted, and has been named *Calomyscus bailwardi*. It adds one more to the list of types of animals once supposed to be peculiar to the New World, but which has been discovered of late years in Asia. Among such it is only necessary to mention wapiti, jumping mice, ocelots, and alligators.

FISH RATS

If we except the water rat, the small mammals that have taken to an aquatic life in Europe and Asia are chiefly shrew-mice, of which several distinct generic types are known, among them being the water-shrew. In South America, on the other hand, it is rats and mice that have adapted themselves to this mode of life. One of these South American aquatic rats feeds on small fishes, and has been described under the appropriate name of *Ichthyomys*, its home being the mountain streams of Peru; a second, distinguished by the absence of ears, has the equally apposite title of *Anotomys*; while a third is *Rheomys*, nearly allied to the second, but distinguished by the retention of ears, and its glossy fur. From both the others, the first-named genus differs by the peculiar structure of its incisor teeth.

Ichthyomys stolzmanni, which has webbed and fringed hind feet, in size comes near the brown rat, but has the head much flattened, larger whiskers, and



AN AFRICAN CRESTED RAT

very small ears and eyes; while in colour it is dark above and whitish beneath, with a black and white tail. A second species, *I. saederstræmi*, distinguished by its darker colour, inhabits the mountain streams of Ecuador. *Anotomys leander*, the representative of the second genus, is found at a great elevation in the mountains of Ecuador. In this species adaptation to an aquatic existence has advanced to such a degree that the ear conchs have completely disappeared,

so that the openings of the ears are reduced to mere slits in the skin. The only other member of the rat tribe in which the ear conchs are absent are the burrowing mole-voles; and it is noteworthy that the only other aquatic mammals in which this feature occurs are whales and dolphins, true seals, and the duck-billed platypus.

GROOVE-TOOTHED MICE

Two groups of American cricetines are distinguished by their upper incisor teeth being marked by parallel grooves. Of these, the American harvest mouse (*Rhithrodontomys humilis*) resembles the rice-field mouse in external appearance, and is found in the southern United States as far north as Iowa; the other species of the genus being also North American.

The rhithrodonts, on the other hand, are exclusively South American, and characterised by their rabbit-like appearance, the head being very short, with a highly convex profile, very large eyes, and rather large rounded ears. In the rabbit-like rhithrodon (*Rhithrodon cuniculoides*), from Patagonia, one of the best-known species, the length of the head and body is 6½ inches, and that of the tail about half as much again. Its general colour is yellowish grey mixed with black, with the under parts pale yellow, and the rump, feet, and lower surface of the tail white.

WOOD-RATS

The Florida rat (*Neotoma floridana*) is a well-known representative of a large genus of North America *Muridæ* distinguished by their large size and the circumstance that the cusps on their molars show some approximation to the type of structure obtaining in the voles. The Florida rat, which inhabits the southern United States and the north of Mexico, is about the size of an ordinary rat, to which it also approximates in colouring, although the under parts and feet are entirely white. This species has a thin, scaly tail, but in the bushy-tailed wood-rat (*N. cinerea*) from the north-western and western districts of North America, this appendage resembles that of a dormouse.

The wood-rats, as the members of the group are collectively termed, are active, climbing rodents, sometimes found in forests, but in other cases inhabiting rocky districts. In woods or near streams they frequently make heaps of twigs, straw, and so forth, in which to form their nests. The young, of which there are from three to six in a litter, cling to the sides and back of the female parent when she is walking about, somewhat after the manner of certain opossums, and two litters are generally produced in the year. In addition to vegetable food, the Florida rat will also eat cray-fish and frogs. These rats are regarded as representing a subfamily connecting the cricetines with the voles.

AFRICAN CRESTED RAT

A remarkable, long-haired rodent from North-East Africa differs from all the foregoing members of the *Muridæ* in certain features which have been regarded as entitling it to rank as the representative of a distinct family, but there can be little doubt that it is merely

a highly-specialised member of the present group. This African crested rat (*Lophiomys imhausi*) derives its name from the great crest of long erectile hairs running down the back and tail, some of which are as much as 3½ inches in length, and at their bases have a peculiar spongy structure. Below this crest there is on each side of the body a broad, longitudinal band of short hair, looking almost as though it had been clipped, which is doubtless of a glandular nature.

The tail is long and bushy, and the limbs short and the ears small. In the hind foot the small front toe can be opposed to the others. The general colour is blackish grey, but there is a large triangular white spot on the front of the head, a white streak beneath each eye, and a white tip to the tail; the long hairs of the body having the middle portion dark coloured, and the two extremities white. Structurally the crested rat differs from other members of the family by its rudimentary collar-bones, and also by the fact that the sides of the hind part of the skull are completely roofed over with bone, as in a turtle. This rodent inhabits Abyssinia and Somaliland, and appears to be arboreal, although nothing definite is known of its habits in a wild state.

Other East African species are known.

WATER RAT AND FIELD MICE

In most works on natural history that common British mammal the water rat (*Microtus*, or *Arvicola*, *amphibius*) will be found mentioned under the name of "water vole." The name "vole" appears to have been originally applied to the water rat and its kindred by Dr. John Fleming, in a work on British animals published in 1828. Although it has no meaning, observed William Macgillivray, this term is preferable to "campagnol"—which was for



THE WATER RAT
Photograph by T. A. Metcalfe

some time in use for these rodents among the naturalists of his day—since it gives an erroneous idea of these animals; whereas the latter, besides being descriptively inaccurate, is a French word of awkward pronunciation.

Since that date "campagnol" has fallen into disuse in England, and been replaced by "vole," formed from the Latin *arvicola*, or the Anglicised "arvicole," which for a while became the common scientific designation for these rodents. The name, however, is an arbitrary and unmeaning one, and although its retention for the group as a whole may be a convenience in zoology, it should not be employed for the British species, for which the vernacular designations of water rat and short-tailed field mice should be reserved. Indeed, since the brown rat is a comparatively recent immigrant into England, while, according to modern investigations, the black, or so-called old English rat, is likewise an alien, which probably reached Great Britain from the east by way of Russia and Germany, or on board ships from the Black Sea ports, it would seem possible that the English name "rat" properly belongs to the water rat, and not to the rodents now designated by that title.

The water rat and the short-tailed field mice, along with the lemmings and the musquash, constitute a group closely allied to the cricetines, but distinguished by the peculiar character of their cheek teeth. Indeed, these rodents are evidently nothing more than a

THE WATER RAT

specialised modification of the cricetine type, and it is more as a matter of convenience than from any well-founded distinctive characters that they are placed by themselves in a distinct subfamily, the *Microtinæ*.

The whole group is characterised by the molar teeth being usually rootless or with imperfect roots, and composed of two longitudinal rows of alternately-arranged triangular prisms. These prisms decrease in number from the first to the third tooth in each jaw, but are variable in number in the different species, and thus form a valuable aid in their discrimination.

The tail is either short or of moderate length, and these rodents are distinguished from true rats and mice not only by this character, but likewise by their more corpulent form, the smaller eyes and ears, more obtuse muzzles, and proportionately shorter limbs. The subfamily has a wide distribution in the Northern Hemisphere, but is unknown in Asia south of the Himalaya, in the Malay region, and in Africa and South America. It is connected with the cricetine subfamily by the North American genus *Phenacomys*, in which the molar teeth are furnished with roots.

The group of voles includes a great number of species, ranging from Britain through Europe to China, and thence eastwards to North America; the genus *Microtus* is sufficiently characterised by the rootless molars and the naked soles of the feet.

From its diurnal habits and wide distribution the water rat is one of the best-known of the indigenous British mammals. In size it agrees approximately with the brown rat, the length of the head and body being about $8\frac{1}{2}$ inches, and that of the tail slightly more than half as much again. The fur is dense and shining, and of a full reddish brown colour, mingled with grey above and yellowish grey below. The feet are not webbed, and the tail is hairy. There are five prisms in the first upper molar, and four in each of the other two. On the other hand, in the common short-tailed field mouse, the first and second upper molars have five prisms each, and the third six; while in the red field mouse the first and third upper teeth have five prisms each, and the second four. A black variety of the water rat is found in several parts of England, generally high up the river valleys.

The water rat has a wide distribution, extending from England in the west to China in the east, and occurring throughout continental Europe. Curiously enough, however, it is unknown in Ireland, where the two species of British short-tailed field mice are likewise wanting.

Every English brook and river is tenanted by the water rat, whose long burrows in the banks are often a nuisance to farmers. The burrows are, however, by no means confined to the banks of rivers, being not infrequent in water meadows and occasionally in ploughed fields at some distance from the water. Although the water rat has been accused of carnivorous propensities, it is doubtful if the charge can be substantiated. Its favourite food in summer is the sweet inner pith of certain kinds of water-flags,

but it will also eat many other aquatic plants, such as duckweed and horse-tails.

In winter, when hard pressed for food the water rat turns its attention to the bark of trees and shrubs, and at this season frequently inflicts serious damage on osier plantations. In cultivated districts it will also then readily eat mangold, turnips, potatoes, and so forth. When feeding on duckweed the water rat sits like a squirrel on its haunches near the water's edge, and taking a lump of the soft and slimy mass in its fore-

paws, eats only a small part, and, letting the remainder fall, picks up some more, which is treated in similar manner.

In May or June, and occasionally so early as April, the female gives birth to five or six young in the depths of the burrow, and it is probable that, when the litter is produced early in the spring, a second one follows during the summer. When their holes are rendered inaccessible by frost, water rats take shelter on shore, sometimes frequenting the covert afforded by an osier bed, and on other occasions seeking refuge in pollard willows. In

spite of its feet not being webbed, the water rat is an expert swimmer and diver; and its coat is of such a nature as to throw off the water as readily as does the plumage of a duck.

Fossil remains of the water rat are found in the cavern deposits of England, and also in the Forest-Bed of the Norfolk coast; while those of extinct species of the same group occur in the Pliocene Crag deposits of Suffolk and Essex.

SHORT-TAILED FIELD MICE.

In addition to the water rat, Great Britain possesses several smaller species of the same group, the commonest of which is the short-tailed field mouse (*M. agrestis*), which is about the size of an ordinary mouse, greyish brown in colour above and greyish white beneath, with dusky feet; the tail being about one-third the length of the body, and the under surfaces of the hind feet having six naked pads. As already mentioned, it is specially characterised by the fact that the second molar tooth in the upper jaw has five prisms. This character, unimportant as it may seem, serves to distinguish this species from the continental field mouse (*M. arvalis*), in which, in common with several other continental short-tailed members of the genus, the corresponding tooth has but four such prisms.

The common short-tailed field mouse is found all over England and Scotland, as well as the greater part of the Continent, its range extending from the north of Italy

to Finland, and from Spain and France to Russia; but in the southern portion of its habitat it is less numerous than the continental field mouse. The English species is found in meadows, especially those where the ground is moist, and makes extensive runs beneath the grass, in which it roams both by night and day, although it is more active in the dark.

In addition to these runs, the field mouse also constructs burrows of considerable size. The food of this species



THE SHORT-TAILED FIELD MOUSE

Photograph by C. Reid



RED-BACKED FIELD MOUSE

Photograph by T. A. Metcalfe

HARMSWORTH NATURAL HISTORY

consists of seeds, roots, and herbage of all kinds. In gardens it displays an especial taste for the bulbs of crocuses and newly-sown peas and beans, among which it often does great damage. In winter, when other food is scarce, field mice not infrequently ascend trees to feed upon their bark; and they are also by no means averse from a diet of insects and flesh.

This field mouse is an unusually prolific animal, producing from three to four litters in a year, and each litter containing from four to six young. The nest in which these are born is composed of moss and leaves, and placed beneath a tussock of grass in some slight hollow in the ground.

The most remarkable peculiarity in connection with these field mice is the swarms in which they occasionally make their appearance in various parts of England and the Continent. One such "mouse plague" appeared in 1580 in Essex, a second visited Hampshire and Gloucestershire during 1813-14, while a third was recorded in Wensleydale which lasted from 1874 to 1876. In the second of these visitations, upwards of thirty thousand mice were destroyed in the Forest of Dean, and eleven thousand five hundred in the New Forest. In 1892 another such plague invaded the south of Scotland, especially in parts of Dumfriesshire and Roxburghshire; the area over which the mice extended being estimated at from eighty thousand to ninety thousand acres.

The habits of the continental field mouse are similar to those of the English species. It is stated, however, to be even more prolific, the number of young varying from four to eight, while as many as six litters may be produced in a single season. Moreover, it is probable that the young produced in the spring will themselves be parents in the following autumn. On the Continent the plagues of these field mice are even more serious than in England. During a visitation in Germany in 1822 upwards of 1,570,000 were taken in one district, 590,327 in another, and 271,941 in a third. Again, in the summer of 1861 a total of 409,523 mice was obtained in a single district of Rhine-Hessen.

Orkney is the home of an entirely distinct species of short-tailed field mouse, *Microtus orcadensis*, differing from the common short-tailed field mouse, not only in external characters, but in the number of folds in the second molar, and being apparently equally distinct from the continental field mouse and the eastern *M. ratticeps* and their immediate relatives. An allied field mouse from the island of Sanday, also in the Orkneys, has been described as a local race of the former species, with the name of *M. orcadensis sandayensis*.

It has, however, been noticed that the Sanday field mouse differs from *M. orcadensis* by its more depressed skull and the frequent presence of a slight peculiarity in one of its molar teeth; and on this ground it has been raised to the rank of a substantive species, *M. sandayensis*, of which a local race from the island of Papa Westray has been named *M. sandayensis westræ*. The case would, however, have been met if the three forms were respectively termed *M. orcadensis*, *M. o. sandayensis*, and *M. o. westræ*. The

short-tailed field mouse inhabiting the island of North Uist, in the Hebrides, has been described as a race of the ordinary British mainland species, under the name of *M. agrestis insulæ*.

Another British representative of the group is the red-backed field mouse, or bank mouse (*M. [Evotomys] glareolus*), which may be distinguished externally from the common field mouse by the colour of the back inclining more or less markedly to rufous, and also by its larger ears, and proportionately longer tail, which is equal to half the length of the head and body. The molar teeth differ from those of the ordinary field mouse not only in the circumstance that in the second one of the upper jaw there are only four prisms, but also in that in the adult state these teeth form imperfect roots.

The whole proportions of the red field mouse are more elegant than those of the ordinary field mouse, while its fur is more smooth and glossy, its colouring more brilliant, and the eye larger. It is found locally over England and parts of Scotland, as far north as Morayshire, while it ranges from France across Asia to China. Its habits are the same as those of other field mice, but it is said to be more generally found in sheltered situations, and is especially fond of visiting gardens. The field mouse (*M. [E.] scolevarensis*),

inhabiting Skomer Island, off the Pembrokeshire coast, differs from the typical *M. glareolus*, not only in colour and its larger size, but also in the structure of the skull.

The Alpine field mouse, or vole (*M. nivalis*), interesting on account of the elevated regions forming its habitat, is a small species with a relatively long tail, the total length being about 7 inches, of which

slightly more than half is taken up by the tail. The ears are large, and the number of prisms in the first upper molar tooth is the same as in the water rat. The colour varies from brownish grey above and greyish white beneath to pure white.

This species has an exceedingly limited distribution, being confined to the Alps and Pyrenees, where it ranges from an elevation of about four thousand feet to the limits of perpetual snow. It is, indeed, most abundant near the snow line, above which it also sometimes wanders in search of the scanty vegetation which exists at such altitudes. Not only is the Alpine field mouse found in these dreary regions during the short season when the ground is more or less free from snow, but it remains there from year's end to year's end. Accordingly, for upwards of nine or ten months of the year it lives beneath a deep pall of snow. Here it makes regular runs, along which it travels in search of food when the supply hoarded for winter use becomes exhausted. No other known mammal leads a similar existence.

The list of species of short-tailed field mice is almost endless, and only the more interesting call for mention. In North America the commonest species is the short-tailed meadow mouse (*M. riparius*), which in the northern regions, during the winter abandons its frozen burrows and forms nests on the surface of the



CONTINENTAL FIELD MICE

LEMMINGS

ground, which soon become buried in the snow. The heat of the little animal inside melts and cakes the surrounding snow, which thus forms a continually increasing dome-shaped mass around the nest. The root mouse (*M. œconomus*), of Siberia and Kamchatka is interesting on account of the large stores of food it accumulates in its burrows, and likewise on account of its migratory habits, which resemble those of



THE ALPINE FIELD MOUSE

lemmings. Numerous kinds of these field mice occur in the Himalaya, Tibet, and Central Asia, one of the best-known Himalayan species being Royle's mouse (*M. roylei*).

The fossil voles of the Norwich Crag and the Pliocene deposits of the Val d'Arno, in Italy, are characterised by having rooted cheek teeth, and are, in consequence, referred to the separate genus *Mimomys*, one of the English species being named *M. newtoni*.

LEMMINGS

Closely related to the short-tailed field mice are the lemmings, of which the Norwegian species (*Lemmus norvegicus*, or *Myodes lemmus*) inhabits the mountains of the Scandinavian peninsula, and thence northwards to the North Cape, while a second, *M. obensis*, is common to Northern Asia and North America. Lemmings are distinguished from the short-tailed field mice, or voles, by their heavier build, more convex and more obtusely snouted head, extremely short tail, and by the soles of the small feet being covered with hair. They have also longer claws, thicker fur, and very small ears; while there are likewise important differences in the structure of the skull and teeth. There is considerable variation in regard to size and colouring in the Norwegian lemming. Usually, however, its length is about 5 inches, while the general colour of the fur is yellowish brown, darker above than below, and more or less spotted and streaked with blackish brown.

Lemmings are the most abundant rodents found in Norway, and have always attracted great interest from the fact that at certain intervals countless swarms descend from the mountains to the plains, and thence make their way, apparently under the influence of some blind impetus, to the sea, into the waters of which they boldly plunge, to meet death by drowning.

In the course of such migrations the lemmings take a straight line across country, swimming rivers or lakes, climbing mountains, and eating their way through fields of corn or grass, and thus leaving a track of desolation in their rear. The line of march is marked

by flights of predaceous birds hovering above the hosts; the flanks and rear of the army being harassed by four-footed foes, which, however, at first make little apparent diminution in its numbers. Disease also claims its victims; and from these combined attacks the numbers which eventually reach the sea, sometimes after an interval of from one to three years from the time of starting, form only a small minority of the original swarm.

In appearance lemmings look not unlike small marmots or hamsters, and resemble the latter to a considerable extent in their mode of life. Although in Finmark they occur at the sea-level, in the more southern parts of Scandinavia they are found only high up in the mountains above the level of firs, in the belt clothed with birch and juniper. Here they select dry spots in the swampy ground, making their shallow burrows beneath stones, or in the peaty soil. Generally, they do not form well-marked tracks from one hole to another, except when the ground is covered with snow. They are on the move by day, as well as by night.

Except when migrating, lemmings show a great aversion to water, always selecting the driest portions of the swamps, and, if forced to enter a river, manifesting their dislike by squeaks and grunts. They sit quietly during the day in or near the entrance of the burrows, but should a human being appear on the scene they at once become violently excited, raising themselves on their hind quarters, and squeaking, as if to warn him off from their territories, while their gestures are such as to give the impression that they are about to attack the intruder. Indeed, they will sometimes bite vigorously at the legs of any person who approaches too close to their holes. The squeaks and grunts uttered on such occasions by the lemmings are said closely to resemble those of guineapigs. In winter lemmings form in their tunnels through the snow large nests, which are exposed to view when it melts; several tunnels radiating from each nest, which are formed partly in the peat and partly in the snow.



THE LEMMING

The chief food of the lemming in its native haunt consists of grass, reindeer-moss, the catkins of the birch, and probably various descriptions of roots. The young are born in the nests, made of dry grass with a lining of hair, and there are usually from five to six young in a litter. It is considered that there is probably more than one litter in a season, but precise information as to the breeding habits of these creatures is still lacking.

It is probable that the periodical migrations of the lemmings are induced by a scarcity of food. If an early spring following a mild winter is succeeded by a hot and dry summer, everything will be favourable for an unwonted increase in the number of these animals. The dry summer will, however, equally tend to diminish the quantity of vegetation available for their support, and, accordingly, a migration to more fertile regions will be rendered necessary. Why the migration should be continued in this extraordinary manner is a question which has not yet received a satisfactory answer. The number of lemmings taking part in a migration has been estimated at many millions; and on such occasions, every bush, rock, and large stone has a lemming hiding under it, while sometimes even the towns swarm with these creatures.

Not only do the lemmings attempt to swim rivers and lakes which are too wide for them to cross, but, writes Mr. T. T. Somerville, "they tumble into holes, wells, and brooks, the sides of which are too steep for them to scramble out of again, so that frequently people are at a loss to obtain water that is not polluted by their bodies. Doubtless this accounts for an epidemic popularly termed 'lemming fever' that is said to prevail after the migration, and is described as resembling ordinary typhoid."

BANDED LEMMING

The banded lemming (*Dicrostonyx*, or *Cuniculus torquatus*), from the circumpolar regions of both hemispheres, differs in several important points from the true lemmings, and is referred to a distinct genus. Externally it is distinguished by the absence of conchs to the ear, the shorter and more thickly-formed feet, the practical loss of the first toe of the fore foot, which has only a rudimentary nail, and also by the great length of the claws of the third and fourth toes in the same limb. The molar teeth are more like those of the water rat than in the case of the true lemmings, but the first of these teeth in the upper jaw is peculiar in having seven distinct prisms. The banded lemming is so variable in colouring as almost to defy description. In general, the fur of the upper parts presents a kind of "watered" appearance, owing to the intimate mingling of chestnut, rufous, black, grey, and tawny; the under parts being leaden grey. Usually a more or less distinct black line runs along the back from the muzzle to the tail; while there may be a greyish collar on the nape of the neck.

In habits the banded lemming is probably very similar to the other species, although it does not undertake similar periodical migrations to the same extent. Baron Nordenskiöld states that there are no lemmings in Spitzbergen, but that they must be exceedingly numerous at certain seasons in Novaya Zemlya, where, in early summer, the grass is seen to be traversed in all directions by the tracks made by these animals beneath the snow. In winter, when they turn white, these lemmings, as already mentioned under the heading of the beaver, develop double claws on the fore feet (page 562).

Remains of both the Norwegian and the banded lemming have been found in the Pleistocene deposits

of Britain, apparently indicating the prevalence of different climatic conditions from those of the present age. The allied genus *Synaptomys* is represented by a small number of North American species.

MUSK RAT

The musquash, or musk rat (*Fiber zibethicus*), is a North American species considerably exceeding in size all other members of the water rat subfamily. Although resembling a water rat in its general external appearance, as well as in the structure of its molar teeth and skull, the musquash differs by its compressed and proportionately longer tail, of which the length is nearly equal to that of the body, exclusive of the head. In addition to its compressed form, the tail is also characterised by being nearly naked and covered with scales. The feet, which are partially webbed, differ from those of the water rat and its relatives in having the soles entirely naked.



THE MUSQUASH

The musquash is a massively-built rodent, with the head and body attaining a length of about a foot, and the tail about 10 inches. The head is unusually wide, and not separated from the body by any distinctly constricted neck; while the eyes are relatively small, and the ears scarcely project above the fur. With the exception of the small area immediately surrounding the nostrils, the muzzle is completely covered with hair. The limbs are short, with the first toe rudimentary in the front ones, although well-developed in the hind pair. The compressed form of the tail is increased by the presence of a line of hairs on both its upper and lower surfaces. The fur, of which the general colour is blackish brown, passing into grey on the muzzle and under parts, has the soft and velvety texture of that of the beaver. It is, however, mostly shorter than in the latter, although on the back and flanks there is interspersed a number of longer bristle-like hairs.

The geographical range of the musquash is large, extending from the so-called Barren Grounds of Arctic America to the genial climate of the Rio Grande, while it also reaches from the Atlantic to the Pacific.

Musk rats are thoroughly adapted for an aquatic life, and frequent ponds, swamps, and sluggish streams. Although their food consists mainly of the roots of grasses and water plants, they consume considerable quantities of river mussels; they will likewise catch and eat fish, while they are said at times to devour the flesh of such individuals of their own species as they may find dead, or wounded and helpless. Occasionally they wander considerable distances from the water; and Dr. C. H. Merriam relates an instance where two of these rodents were discovered comfortably ensconced beneath the hearthstone of a room.

The musquash is an excellent diver, being able to remain below the surface of the water for a considerable time. It is much less strictly nocturnal in habits than the beaver, and may frequently be observed swimming about in broad daylight, more especially if the sky be overcast. In leaping into the water to dive, it makes a loud noise by striking the flat tail against the surface. The long burrow always has its entrance beneath the surface of the water, from which it inclines upwards

RATS

in the bank for a distance of from 10 to 15 feet, when it expands into a large chamber, in which may be a nest. Usually one or more galleries lead from this chamber farther into the bank.

In certain districts where the water is deep these animals in the autumn sometimes collect large heaps of vegetable matter in the form of haystacks. Such heaps are known as "musk rat huts" or "houses." After mentioning that some of those built in the water attain enormous dimensions, Dr. Merriam observes that "the summit of the structure is commonly high enough out of water to admit of an air-chamber within, which communicates with the outside world by means of a hole through the centre of the mass, the entrance or entrances being under water. Many of the houses contain no mud or sticks, but consist wholly of knots of roots and balls of swamp grasses. It seems clear that the animals make no attempt to construct a dwelling of any particular shape, but merely heap the materials together without plan or order, the resulting mound naturally assuming, in a general way, the form of a flattened cone. The materials of which the hut are composed, it will be observed, are such as serve as food for the animals during the long winters; hence the musk rat's house is in reality a storehouse, which he devours piecemeal as the winter advances."

The nest is usually placed in a burrow in the bank, although occasionally in the aforesaid hut. Here from five to nine blind and naked young are produced at a birth, and it is reported that there may be as many as three litters in the course of a season.

Although not of much value, the fur of the musquash is largely used both in America and Europe; from three to four million skins coming into the market annually, and the Hudson Bay Company alone having sold over half a million in one year. Although the flesh of the musquash is red and rather flabby, yet, failing other meat, it is eatable.

MOLE VOLES

A curious rodent from Southern Russia and Central Asia, which, for want of a better name, may be called the mole vole (*Ellobius talpinus*), has burrowing habits, and may be distinguished from the zokor by its short front claws. Another member of the same group, the so-called Quetta vole (*E. fuscicapillus*), is about 5 inches in total length, of which half an inch is occupied by the tail. It is brownish white above, with the exception of the greyish brown head, while the under parts, feet, and tail are white, the fur being long and soft. It is reported to construct horizontal galleries in the ground, with heaps of earth thrown up at intervals, after the fashion of the mole. A third species, *E. lutescens*, inhabits the Caucasus and Kurdistan.

Another curious burrowing rodent from the Caucasus is *Prometheomys schaposchnikowi*, distinguished, among other features, by its triangular skull.

ZOKORS

The zokor (*Myotalpa*, or *Siphneus, aspalax*) of the Altai, Siberia, and Mongolia, which typifies a separate subfamily, the *Myotalpinæ*, is likewise subterranean in

its habits, and presents a curious superficial resemblance to the mole vole, from which, however, it may always be distinguished by its long front claws. In form this rodent is characterised by the blunt and rounded head passing imperceptibly into the cylindrical mole-like body, the absence of external ears, the short tail and limbs; and the broad feet, each provided with five claws. The incisor teeth project considerably, and their enamel is usually white, instead of having the yellow or orange tinge so prevalent among the voles. Other species, inhabiting Siberia, Mongolia, and China, are known.

RATS AND MICE

The true rats and mice, with certain allied forms referred to distinct genera, are the representatives of the typical subfamily (*Murinae*) of the *Muridæ*, which is exclusively confined to the Old World. They are primarily characterised by the crowns of the unworn upper cheek teeth carrying a number of tubercles arranged in three longitudinal rows; these teeth always having distinct roots. When worn by use, the crowns of the molars exhibit transverse bands of enamel. The tail is always long and scaly, and in most cases almost destitute of hairs; the ears are large, and the eyes bright and prominent, while the muzzle is sharply pointed, and the build light and elegant. Their movements are quick, active, and graceful, and their colouring is in most cases uniform and sombre, as would naturally be expected from the nocturnal and burrowing habits of the majority of the species.

The murine subfamily includes a considerable number of species, by far the great majority of which are comprised in the genus *Mus*. This genus is characterised by the incisor teeth being smooth, and the molars distinctly tuberculated. The ears and eyes are proportionately large, and the tip of the muzzle is naked, while the tail is long and scaly. The first toe of the fore foot has a short nail in lieu of a claw; and the fur is soft, although in some cases intermingled with spines. The genus is the largest in the whole mammalian class, comprising an enormous number of species, distributed over the whole of the Old World with

the exception of Madagascar; some of these, by human aid, having now acquired a cosmopolitan range. Only the more interesting kinds can be noticed.

For convenience of description, this extensive genus is split into a number of subgeneric groups. Among these, the typical *Mus* is represented by the house mouse; *Epimys* includes the rats in which the cheek teeth are of a more specialised type; *Apodemus* the long-tailed field mouse; and *Micromys* the harvest mouse; the

last of these being specially distinguished by its prehensile tail. Some naturalists raise these groups to the rank of genera, but this is unnecessary.

THE BROWN RAT

The brown, or, as it is often inappropriately called, the Norway, rat (*Mus* [*Epimys*] *norvegicus*, or *M. decumanus*) offers one of the most remarkable instances of a successful usurpation to be found in the animal kingdom; this



THE BROWN RAT

rodent having ousted the black rat from most parts of England and a large area on the Continent. So far as can be ascertained, its original home appears to have been Western China, whence it gradually travelled westwards to continental Europe, finally reaching the shores of the British Isles by the aid of ships. Its westerly migration, however, was by no means limited to Europe, as it has been carried by vessels across the Atlantic, and is now as abundant in many parts of North America as it is in the Old World. The migration of the rat in Russia is known to have taken place about 1727, in which year large troops of these animals crossed the Volga from Central Asia, and made their way westwards. In Paris they appeared about the middle of the eighteenth century, and they are supposed to have first reached England in 1730.

In form the brown rat is characterised by its heavy build, massive blunt muzzle, comparatively small ears, and relatively short tail; the length of the tail being always less than that of the head and body (8 to 9 inches), and usually not exceeding that of the body alone. The colour of the upper parts is greyish brown, while the under surface is white; but black varieties are often met with, which in Ireland have been regarded as indicating a distinct species.

The brown rat is a far more powerful animal than the black species, which has not a chance against its stronger rival, although, curiously enough, it is stated that on some ships the two kinds may be found living together. The following anecdote, related by Mr. F. Buckland, illustrates in a striking manner the superior power and at the same time the extreme ferocity of the brown rat. "A London rat-catcher shut up together in a cage the result of his day's work, consisting of several dozen rats, of both species, and put them away carefully for the night, their intended fate being to afford sport for his employer's dogs the next morning. What was his astonishment when he came to fetch them to find none but brown rats remaining, these cannibals having cruelly devoured all their sable brethren."

Rats are practically omnivorous in their diet, devouring every kind of human food with avidity, and inflicting untold damage on the hen-roost, the dovecot, and the rabbit-warren. Their devastations to corn-ricks, or to grain stored in insufficiently protected granaries, are well known. Not only will they, as in the instance just recorded, prey on their cousin the black rat, but they will likewise slay and devour members of their own kind which have been caught in traps or otherwise disabled. In robbing poultry-houses, it is a well-ascertained fact that rats will convey the eggs in an unbroken condition for considerable distances, although it is not yet ascertained how this difficult feat is accomplished. The partiality of these animals for fishes is well known, and they will occasionally catch young eels for themselves. Snails—both land and freshwater—also form a portion of their diet; while on the sea coast they will eat prawns and other crustaceans.

There is also another heavy indictment against the brown rat, which, as mentioned in the introductory sketch of the rodent order, appears to be the chief agent, by means of its parasitic fleas, in the dissemination of plague (page 547).

The prolific nature of the brown rat is little short of marvellous, and thoroughly accounts for its enormous numbers when in favourable situations. Several litters are produced annually, each of which contains from eight to ten, and sometimes as many as twelve or fourteen young; a female rat may breed when only half-grown, although the number of its progeny is then but three or four at a birth. When these rodents obtain access to small islands inhabited by sea-birds or rabbits, the abundant food soon leads to a prodigious

increase in their numbers; but earlier or later they practically exterminate the indigenous inhabitants, and then have to seek a more precarious livelihood by preying upon the crustaceans and molluscs on the shores.

Rats, impelled by scarcity of provisions, at times make migrations in large bodies—generally, or always, during the night, and on such journeys will not hesitate to plunge boldly into and swim over such rivers as may come in their way; it is related that instances have occurred of their being suddenly hemmed in during such voyages by a rapid formation of ice. Many years ago the rats that frequented the London Zoological



YOUNG BLACK RAT

Gardens were in the habit of regularly swimming to and fro across the Regent's Canal. When brought to bay, the ferocity with which a rat will defend itself against a human or canine foe is known to most persons. When pressed by hunger, however, rats will occasionally attack human beings without provocation; and it is on record that an unfortunate man entering a coal-pit which had been closed for some time, was actually killed and devoured by a host of starving rats.

THE BLACK RAT

The black rat (*Mus rattus*) is a smaller and more elegantly built rodent than the brown species, and has a longer and thinner tail; the length of the head and body being about 7 inches, while that of the tail varies from 8 to 9 inches. Its snout is also longer and more slender, projecting to a greater distance beyond the lower jaw, while its ears are considerably larger. In Europe the black rat, as its name implies, generally has fur of a deep bluish black colour; but in India and other parts of the East there are several local races, in one of which the tint is usually brown above and white below, while in a second the hue is rufous or yellowish brown, and spines are mingled with the fur. In one of these Indian races the length of the head and body is not more than 5 inches, while in another it reaches 8 inches.

The black rat (page 137) is very commonly spoken of as the indigenous British species; this, however, is incorrect, as it was introduced from the East, although at a much earlier date than its brown cousin. The exact date of its arrival in Europe cannot now be determined, although the species is known to have existed on the Continent in the thirteenth century. At the present day the European race of this species is almost cosmopolitan; but the brown and rufous races, such as *M. r. alexandrinus*, extend from Northern Africa through India to Burma, and are doubtless indigenous to both these regions, while other races occur in New Caledonia, New Zealand (the so-called "Maori rat"), and the Galapagos Islands.

THE HOUSE MOUSE

The black rat, in addition to its inferior size, is a far less ferocious animal than the brown species, which accounts for the ease with which it has been conquered by the latter. In England it is now comparatively rare, but it is more common in certain parts of the Continent. In Europe its habits are generally very similar to those of the brown rat, but in India it frequently ascends trees, where it makes its nests among the branches, while in some of the islands of the tropics it lives exclusively in the crowns of the cocoa-nut palms, upon the fruit of which it feeds.

It is commonly stated that domesticated white and pied rats are derived from the brown rat; but on this point Mr. R. I. Pocock observes that it "would be interesting to get evidence in favour of this belief, which appears to be commonly, but, I think, erroneously, entertained. I formerly kept numbers of pet rats, and bred them extensively. They were all either white, piebald, skewbald, or black varieties of *M. decumanus*. They had all the characters of that species, and would breed freely with wild-caught examples. I failed, on the other hand, to obtain a cross between females and a male example of *M. rattus*, and had great difficulty in getting them to agree. I may add that I have never seen a tamed specimen of *M. rattus*, and if the prevalent belief regarding the domestication of the latter

hood; its tastes being practically omnivorous, although its chief food consists of grain and other vegetable articles of human consumption. It is noteworthy that in corn-stacks rats and mice live in perfect harmony together, without any trace of that mutual antipathy characterising the brown and the black rat. The mouse is nearly as prolific as the brown rat, producing from three to five litters in a year, each of which includes from four to eight blind young. In habits it is more active than most of its kindred, being able to ascend vertical walls with ease, and also having the power of springing to considerable distances. In domestication white and pied breeds of this species are common.

Mice exhibit a peculiar susceptibility to musical sounds, to which they listen with marked attention. Occasionally, in common with other members of the family, individuals of this species are endowed with considerable vocal powers. A lady writes that although the song of one of these "singing mice" was not very effective, yet it was a distinct vocal effort. Sometimes the mouse in her possession "would run up an octave, and end with a decided attempt at a trill. Sometimes it would try to trill up all the notes. An octave seemed to be about its range. I could distinctly see the expansion and vibration of its throat and chest as one can in a song-bird. Its favourite position when singing, was an erect one, standing on its hind feet."

To this species belong the so-called "waltzing mice." Although these remarkable mice are commonly called either Japanese or Chinese, their real home is China, since they are known in Japan as Nankin mice. In Japan, where there were originally a grey and a white breed, these mice are kept in cages on account of their well-known dancing propensities. After an examination of their internal auditory organs, Dr. K. Kishi has come to the conclusion that the dancing of these mice is not due, as often supposed, to disease of the labyrinth of the ear,



THE BLACK RAT

species be correct, there can be no doubt that our pet rats are hybrids."

THE MOUSE, OR HOUSE MOUSE

In Britain, owing to the absence of any species of intermediate size, it is easy to distinguish between the rats, or larger species of the genus, and the smaller mice, but in other countries it is less easy to draw any line of distinction, and the two terms must consequently be employed in a somewhat arbitrary manner. The typical representative of the mice is the common or house mouse (*M. musculus*), which is now of almost world-wide distribution, although probably originally a native of Asia. The characteristic features of this species are its relatively large ears, long tail, and nearly uniform brownish colour, which is only slightly paler below than above.

The mouse of the Faroe Islands is a large and stouter-built animal than the common house mouse, from which it also differs in colour. It is, therefore, regarded as representing a distinct local race of that species. St. Kilda has also a peculiar mouse of its own.

The distinctive peculiarity of the house mouse is its partiality for human habitations and their neighbour-

hood, but to the effect of confinement for untold centuries in small cages.

THE LONG-TAILED FIELD MOUSE

Since the term "field mouse" is applied to the voles as well as to the true mice, it is necessary to prefix the epithet "long-tailed" to the common British species (*M. [Apodemus] sylvaticus*) of the present genus. This field mouse is rather larger than the short-tailed field mouse, from which it can be distinguished by its lighter build, longer and more pointed muzzle, much larger ears, and greatly elongated tail, which is nearly equal in length to the head and body. The colour of the fur is reddish grey above and whitish beneath, with a spot of light brown on the chest. This species is common in many parts of England, and widely distributed over the temperate regions of Europe, while eastwards it is replaced by the closely-allied Persian field mouse, ranging from Persia over a large portion of Central Asia.

This field mouse is found in England in gardens, hedge-rows, and corn-fields, but in winter sometimes takes shelter in houses, while it also frequents corn-stacks, although in less numbers than does the house mouse.

It burrows in the ground and lays up large stores of food for winter use; whole handfuls of corn, nuts, or seeds being sometimes discovered in these subterranean retreats. Since these mice are exceedingly prolific, the amount of damage they can do to corn-fields and gardens is almost incalculable; and additional harm is frequently effected by pigs in their search after the concealed hordes of these little rodents.

The long-tailed field mouse, of which the typical form occurs in Sweden, is represented by a number of local races in the British Isles. In addition to the one found over the greater part of the country, there are the following races, namely, the large *M. s. flavicollis*, from Hereford and Devon; *M. s. hirtensis*, from St. Kilda; *M. s. hebridensis*, from Lewis and Barra in the Outer Hebrides; *M. s. celticus*, from Skye and the Outer Hebrides; and *M. s. firdariensis*, from Fair Isle, to the south of the Shetland group.

The field mouse of Fair Isle is considerably larger and more brightly coloured than the ordinary mainland race, in both of which respects it approaches *M. s. flavicollis* of the south-west. It is, however, less bright than the latter, and also lacks the yellow chest band so distinctive of that race. It further differs in the proportionately smaller size of the ears, in which respect it approaches *M. s. hebridensis*; on the other hand, the tail is considerably longer than in either *M. s. hebridensis* or *M. s. hirtensis*, while the hind feet are smaller, although quite as stout as in the latter.

THE HARVEST MOUSE

This little rodent (page 523) is the most beautiful and almost the smallest of the British mammals, the one inferior to it in point of size being the pigmy shrew-mouse (page 67). The harvest mouse (*M. [Micromys] minutus*) was first discovered in England by the Rev. Gilbert White, of Selborne, and is so small that its weight is only about one-sixth of an ounce; the length being about $4\frac{1}{2}$ inches, of

which only one-half is taken up by the tail. The ears and tail are proportionately rather small, and the colour of the fur is yellowish red above and white beneath.

The harvest mouse, although local, is widely distributed in the British Isles, and extends over the greater part of Europe, ranging eastwards through Russia into Siberia and Japan, and occurring as far south as the north of Italy. This species usually keeps far away from human habitations, frequenting corn-fields and pastures, but is often carried home with corn-sheaves, and then spends the winter in the rick where it is deposited. In the latter situations harvest mice remain active throughout the year; but when living in the open fields they construct burrows in which to pass the winter months in a state of torpor. The summer nest is a globular structure of grass and leaves suspended among the corn-stalks at some distance from the ground; and when ascending or descending the straws to reach this nest, or in search of food, the little rodents are much aided by their prehensile tails.

No better description of the nest exists than the one given by Gilbert White. The structure was "most artificially plaited, and composed of the blades of wheat; perfectly round and about the size of a cricket ball, with the aperture so ingeniously closed that there was no discovering to what part it belonged. It was so

compact and so well filled that it would roll across the table without being discomposed, though it contained eight little mice that were naked and blind." The number in a litter varies from five to eight or nine, and it is probable that there are several broods in the course of a summer. The number of the species, however, is kept down by the host of predacious birds and small carnivorous mammals that make it their prey. Like the long-tailed field mouse, the present species is partly insectivorous in its diet. Mr. J. E. Harting states that he has several times kept harvest mice in captivity, and succeeded in rearing their young to maturity. He describes them as charming little pets, allowing themselves to be handled without making any attempts to bite, and readily taking food from the hand.

The Japanese race is darker-coloured than its British representative, which is likewise racially distinct from the typical Continental form.

The Australian brown-footed rat (*M. fuscipes*) is remarkable as being nearly or quite as aquatic in its habits as the water rat.

AFRICAN STRIPED MICE

The Barbary striped mouse is one of a number of strikingly coloured African mice forming the genus *Arvicanthis* by themselves. In this species the ground colour of the fur of the upper parts is yellowish brown, upon which is a number of longitudinal blackish brown stripes, the under parts being pure white. This mouse inhabits North-Eastern and West and Central Africa, being especially common in the Atlas Mountains, and also occurring in the desert regions of the interior as far as Kordofan. Other species extend the range of the genus from Abyssinia to Cape Colony.



THE MOUSE

BANDICOOT RATS

The bandicoot rats of Southern Asia differ from the

ordinary rats in the much greater width of their incisor and molar teeth, and also in the tubercles on the crowns of the latter being so completely connected as to form transverse ridges. Members of the genus extend from Palestine to Formosa, and from Ceylon to Central Asia, but they are most abundant in India and the adjacent regions.

The great bandicoot rat (*Nesocia bandicota*) is one of the largest members of the sub-family, measuring as much as from 12 inches to 15 inches from the tip of the snout to the root of the tail, and weighing between $2\frac{1}{2}$ and 3 pounds. It is common in cultivated districts and near human dwellings in most parts of India, although unknown in Lower Bengal. It is a burrower, like other species of the same genus, some of which turn up mounds of earth like mole-hills. When disturbed, this rat utters grunts like a pig, it has far less pluck than the brown rat, and makes but a poor fight against a dog. There are about a dozen members of the genus.

OTHER RATS AND MICE

There are numerous other genera belonging to this section of the family, of which only a few of the more interesting can be briefly noticed.

The bush rats (*Golunda*), represented by one Indian and several African species, are distinguished by the

MOLE-RATS



LONG-TAILED FIELD MOUSE

presence of a groove on the front of the upper incisor teeth. The length of the head and body in the Indian species (*G. ellioti*) is about $4\frac{1}{2}$ inches, and that of the tail half an inch less.

The spiny mice (*Acanthomys*, or *Acomys*), of which there are several species of the approximate size of the

house mouse, are peculiar in having the hind portion of the back covered with thick, rigid, grooved spines in place of hair, and thus look almost like minute hedgehogs. They are desert-loving creatures, ranging from Syria to Eastern Africa as far south as Mozambique, while a single example of one of the species has been found in Sind, and an outlying species inhabits Cyprus.

The mountains of Luzon, in the Philippines, are the home of a rat (*Crateromys schadenbergi*) as large as the whip-tailed Philippine giant rat, but distinguished by the bushy tail and the structure of the cheek-teeth, which are like those of ordinary rats. The colour may be pale grey above and white below, or wholly black. In habits this rat is arboreal. *Carpomys* and *Batomys* are allied but smaller rats from the same mountains. Here also may be mentioned the great Gambian rat (*Cricetomys gambianus*), representing a genus by itself and measuring a couple of feet in total length.

The sandy deserts of Australia are inhabited by certain elegant rats distinguished by their elongated hind limbs, long ears and tail, and jerboa-like appearance, these jerboa rats, as they may be called, apparently taking the place of the true jerboas in the regions they inhabit. These rats, of which there are numerous species, varying considerably in size, have been generally included in the single genus *Conilurus*, but it has recently been proposed to split the group into several genera.

A peculiar species from Tasmania known as Lichtenstein's rat (*Mastacomys lichtensteini*) differs from ordinary rats in the great width of the molar teeth, and also in the circumstance that the female has but four teats. It somewhat resembles the water rat in size and form, although the body is clothed with longer and softer fur.

THE MOLE-RATS

WITH the strange-looking mole-rat we take leave of the *Muridæ* and come to a small family (*Spalacidæ*) of Old World rodents adapted for a purely subterranean mole-like life. Except for their large and projecting incisor teeth, which at once proclaim them members of the rodent order, the mole-rats have a mole-like appearance, their eyes and external ears being small or rudimentary, the limbs short and provided with large and powerful claws, and the tail usually short or practically wanting, while the body is cylindrical and not marked off from the head by any distinct neck. Their cheek teeth are furnished with roots, and have re-entering folds of enamel on their crowns, premolars being invariably absent.

It may be remarked that the assumption of mole-like habits and a more or less mole-like bodily form is common to several groups of smaller mammals. Thus among the Insectivora we have the true moles and the golden moles, while in the rodents we find mole-like forms in the mole-voles and zokors in this and the last families, and also in the South American tucutuco, belonging to the family *Octodontidæ*. Finally the marsupial mole of Australia presents an example of the pouched mammals having a similar form and mode of life.

The great mole-rat (*Spalax typhlus*), the typical representative of its genus, is characterised by the minute eyes being completely covered with skin, and the rudimentary wart-like ears. The fur is soft, and so arranged as to be

reversible, by which means the movements of the animal in its burrow are much facilitated. The general colour is yellowish brown tinged with ashy grey above, and ashy grey, mingled with spots and flecks of white, beneath.

Mole-rats inhabit South-Eastern Europe, whence they extend eastwards to Syria, Mesopotamia, Persia, and Lower Egypt. The Egyptian form has been separated as a distinct species from the typical *S. typhlus*, although it may be a question whether it is more than a local race.



THE HARVEST MOUSE



A JERBOA-RAT

The great mole-rat constructs tunnels very much resembling those of the mole, their course being marked by heaps of earth thrown out at intervals. But while the mole constructs its lengthy burrows for the sake of feeding upon earth-worms, the present species and its allies make their subterranean journeys in search of bulbs and roots. In Egypt the burrows of the mole-rat are made in sandy soil containing quantities of bulbs of asphodels and hyacinths, upon which these rodents feed.

The tunnels are of great extent and complexity, some of the passages being thirty or forty yards in length, and are generally about eighteen inches below the surface. In certain spots, however, the borings descend to a depth of some four feet, and here some of them terminate in chambers packed full of bulbs, while others open out into sleeping apartments, from which secondary passages again radiate. The tunnels are perfectly smooth and cylindrical, and in digging through the soil above them numerous bulbs of the same kind as those found in the storehouse may be observed. When taken from its burrow, the first instinct of the animal is to dig headlong into the soil; and when underground it is able to move with equal facility either backwards or forwards.

Although the eye of the mole-rat is completely buried beneath the skin—which probably permits the passage of a certain amount of light—and is thus

STRAND MOLES

AFRICA south of the Sahara is the habitat of several kinds of burrowing rodents differing from the mole-rats and bamboo-rats in the form of the lower jaw and the general presence of premolar teeth. These constitute the family *Bathyergidae*, of which the typical representative is the strand mole (*Bathyergus maritimus*) of the Cape, a rodent nearly a foot in length, with the upper incisor teeth grooved, no external ears, and extremely powerful claws; the silky hair being of a light greyish brown colour. The strand mole which is always found on the flats near the shore, constructs numbers of tunnels and hillocks, the former of which are large enough easily to admit the hand and arm. On the other hand, the runs of the smaller members of the group, such as *Georchus capensis*, are generally constructed on higher ground, although sometimes with those of the strand mole. The hillocks constructed by the latter are about a foot in height, those freshly made being of a dark colour.

Professor H. N. Moseley writes that "one has not long to watch, standing a few yards off, before the fresh heap is seen to heave up, three or four times in succession, as the strand mole forces freshly scooped-out

functionless, yet all the essential structural features of that organ are present—only they never develop beyond the initial stages.

BAMBOO-RATS

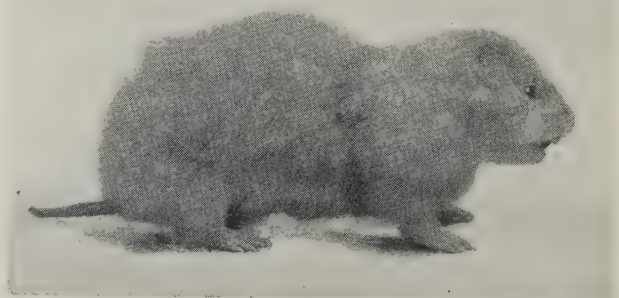
In Northern India, Tibet, China, Burma, and the Malay region, as well as in North and East Africa, the family is represented by a group of species commonly known as bamboo-rats, which differ from the mole-rats in the minute eyes not being covered with skin, as well as in the presence of small external naked ears, and of a short tail partially covered with hair. The bay bamboo-rat (*Rhizomys badius*), ranging from the Eastern Himalaya to Siam, is one of the best-known

representatives of the genus, and attains a length of from 7 to 9 inches, exclusive of the tail, which is about 2½ inches more. This species makes its burrows among tall, rank grass, and sometimes at the roots of trees, and in their construction uses its teeth as well as its claws. There is some doubt whether these rodents drive tunnels in search of roots, as they are known to issue forth at night in order to feed on the young shoots of grass, and probably bamboo, but it is believed that they also eat roots.

When above ground, these bamboo-rats move slowly, and are said to be so fearless, or stupid, as to allow themselves to be caught without resistance, although when taken they bite savagely and severely. From three to four young are produced at a birth. The hill tribes of Burma are in the habit of eating the flesh of these animals. The Sumatran bamboo-rat (*R. sumatrensis*), ranging from Tenasserim to Siam, is a much larger species, measuring from 15 inches to 19 inches in length, exclusive of the tail.

Largest of all is the Sze-chuen bamboo-rat (*R. vestitus*) of North-Western China, characterised by its long coat. Remains of an extinct bamboo-rat occur in the Pliocene rocks of the Siwalik Hills at the foot of the Himalaya. The African bamboo-rats, which range from Abyssinia to the Kilimanjaro district, are referred to a separate genus, *Tachyoryctes*, mainly on account of the structure of their cheek teeth.

earth up into it from below. I tried at first shooting into the heap as it was thus heaving, in the hope of getting the mole, but never with any success. In



A BAMBOO-RAT

order to shoot the worker the earth should be quickly thrown back from the fresh heap, and the hole laid open to the air. One then only has to retire about ten

POCKET GOPHERS

paces and wait patiently. The strand mole does not like the fresh air, and in the course of five minutes or so comes back to fill up the hole, but usually puts its head out for a moment first to find what's up, though it certainly cannot see far with its minute eyes, which are not bigger than the heads of carpet pins, the whole eyeball when extracted being not bigger than a tenth of an inch in diameter." When trapped, the animal bites the air fiercely with its enormous front teeth, at the same time uttering a half-snarling, half-growling noise.

Although there is but a single species of *Bathyergus*, there are several of the allied genus *Georychus* in different parts of Africa; all the latter being distinguished by their smaller size, smooth incisors, and smaller claws. In addition to these, there is an allied genus known as *Myoscalops*, characterised by having usually three pairs of premolar teeth in each jaw, in addition to the three molars; this genus is represented by a few species from Eastern and East-Central Africa.



STRAND MOLES

SAND RATS

The sandy deserts of Somaliland and Shoa are inhabited by two members of the family *Bathyergidae*, which are some of the most extraordinary-looking little creatures in existence. In size these naked sand rats may be compared to a house mouse, but in appearance they have been likened, on account of their nearly naked skin, small eyes, and peculiar physiognomy, to tiny hairless puppies. They have small heads, with projecting incisor teeth, and no external ears, while the limbs and tail are of moderate length. The eyes are almost functionless; and, although the feet are fringed with hairs, the yellowish skin is almost naked, save for

a few sparsely scattered hairs. The Abyssinian species (*Heterocephalus glaber*) has three pairs of molar teeth in each jaw, while in the Somali kind (*H. phillipsi*) there are only two.

These sand rats are entirely subterranean in their habits. Mr. Lort Phillips states that they throw up "groups of miniature craters, which exactly represent volcanoes in active eruption. When the little beasts were at work I used frequently to watch them, and found that the loose earth from their excavations was brought to the bottom of the crater, and sent with great force into the air in a succession of rapid jerks, but they themselves never venture forth from the shelter of their burrows."

POCKET GOPHERS

THE possession of large cheek pouches lined with hair, which open externally to the mouth at the lower edges of the cheeks, forms the distinctive peculiarity of a family of rat-like rodents confined to the New World, where they are known as pocket gophers. In addition to three pairs of molar teeth with transverse plates of



COMMON POCKET GOPHER

enamel on their crowns, and which may or may not be rooted, these rodents have a single pair of premolar teeth in each jaw. Their skulls are characterised by the great twisting of each branch of the lower jaw, and by the forward extension of the cheek bone. Collectively, they constitute the family *Geomyidae*, the

members of which are arranged by American naturalists in a number of genera, among which those respectively named *Geomys* and *Thomomys* are the most important.

Pocket gophers are large rat-like, burrowing rodents, characterised by their small eyes, rudimentary external ears, and the equality in length of their comparatively short limbs; all are confined to North and Central America.

The common pocket gopher (*Geomys bursarius*) is one of the best-known representatives of the group, and the type of the genus *Geomys*, characterised by the presence of a deep groove on each of the broad upper incisor teeth. This species attains a length of from 7 to 8 inches from the muzzle to the root of the tail; while the hairy tail itself varies from 2 to 3 inches. The fur is of a soft and mole-like texture, and of a beautiful reddish brown colour above, becoming greyish beneath, while on the feet, and generally also on the tail, it is white.

This pocket gopher is an inhabitant of the extensive plains of the valley of the Mississippi and its tributaries, extending somewhat beyond these limits to the north. Here it lives a mole-like life, constructing subterranean tunnels and throwing up at intervals conical heaps of earth, after the fashion of the "little gentleman in black velvet." The tunnels run at a distance of about a foot below the surface; but sometimes, as when passing beneath a garden path, they descend deeper. They are driven for the purpose of obtaining access to

the roots of plants on which these rodents chiefly subsist. The tunnels communicate with one another by cross-passages; and in a certain spot—generally beneath the roots of some large tree—the animal sinks a deep shaft, at the termination of which is constructed a dwelling chamber. This chamber is generally from 4 to 5 feet below the surface, and entered by a tortuous passage. It is of large size, and lined with soft grass, upon which the owner reposes.

The nest of the female is constructed in a similar chamber, which is, however, encircled by a horizontal gallery, after the manner of the residential chamber of the mole. Here in the latter part of March or beginning of April are produced from five to seven young, their nest partly consisting of soft fur from the body of the mother. Generally a passage proceeds from one side of the nest chamber to a store chamber, which is filled with roots, nuts, and seeds—in cultivated districts potatoes often forming a large proportion of its con-

tents. The food is said to be carried to this storehouse in the capacious cheek pouches of the animal. Usually the pocket gopher works at its tunnels or domicile from about four to ten o'clock in the morning, during which time it excavates from twelve to twenty feet of tunnelling, and will throw up from two to five hillocks. Other species belonging to this genus are found in the southern United States, Mexico, and Central America.

The northern pocket gopher (*Thomomys talpoides*) is a well-known representative of a second genus, containing numerous species, distinguished from *Geomys* by the absence of grooves in the upper incisor teeth. This species measures from 6 to 8 inches in length, and the tail some 3 inches more; while its general colour is very similar to that of the brown rat. The rodents of this genus are distributed over the whole of Canada and North America west of the Rocky Mountains. In habits they precisely resemble the preceding genus.

KANGAROO-RATS AND POCKET MICE

THE kangaroo-rats and their smaller allies the pocket mice are quite unlike the pocket gophers in appearance, having elongated hind limbs and tails, large eyes, and well-developed ears, while their habits resemble those of the jerboas. They agree with them, however, in the possession of large external cheek pouches, and their general internal structure, although their upper incisor teeth are proportionately much narrower, and there are certain peculiarities in the conformation of the skull. They form the family *Heteromyidae*.

From their relatives, kangaroo-rats are distinguished by the molar teeth being rootless. One of their best-known representatives is Phillips's kangaroo-rat (*Dipodomys phillipsi*), which inhabits the desert regions of Mexico, both mountains and plains, and is characterised by the possession of four toes on the hind feet.

The head and body of this graceful little rodent measures a little over 4 inches in length, while the tail is very long and tufted at the end, and the general build light and elegant. The colour of the upper parts is mouse-brown, becoming tawny on the flanks, but the under parts, the tip of the tail, and a spot above each eye are white or yellowish. Other species inhabit the United States.

A second genus (*Perodipus*) is typified by the agile kangaroo-rat (*P. agilis*) of California and the Sierra Nevada, and also includes Ord's kangaroo-rat (*P. ordi*) of Texas and Idaho, which are rather larger and more stoutly-built animals, with relatively shorter tails and five toes on each hind foot, together with several other species. A third genus is represented by *Microdipodops megacephalus*, of the eastern United States, and a few other species.

The habits of these kangaroo-rats, which must not be confounded with the animals called by the same name in Australia, are very similar to those of jerboas, these rodents frequenting the most arid districts they can find, and living in burrows made beneath rocks or stones. In such districts there is no water, and little vegetation, save gigantic cactuses, and the food of the kangaroo-rats consists of the roots, blades, and seeds of

the scanty grass that manages to struggle into existence. Probably the only water these creatures drink is derived from dew collected on the cactuses. Little or nothing seems to be known of their breeding habits.

Dr. R. W. Shufeldt states that he once had three kangaroo-rats in captivity belonging to the species known as *Perodipus richardsoni* and which became quite tame after a few weeks in confinement. "They hopped about," he writes, "with great agility on their hind pair of kangaroo-like legs, while the little short pair of anterior limbs were curled inwards on the chest. They are able climbers, and the rapidity with which they can dig a burrow in ordinary ground is astonishing. They use the fore feet to perform the digging part and the long and strong hind legs to kick the loosened soil out of their way behind, as it

accumulates every moment or so. In soft soil one of these little mammals can put itself out of sight in less than a minute by digging." He adds that these kangaroo-rats are in the habit of turning their cheek pouches inside out in order to clean them.

The tiny little rodents known in the United States as pocket mice (*Heteromyidae*) are

distinguished from the kangaroo-rats by the presence of roots to their molar, or cheek, teeth, and also by their inferior size—the whole length of the head and body seldom exceeding a couple of inches. The genus *Perognathus*, as typically represented by the banded pocket mouse (*P. fasciatus*) of North America, is characterised by the hair being coarse and bristly; whereas in the genus *Heteromys*, of which representatives extend as far southwards as Trinidad, the fur is mingled with a number of flattened spines. Most of these rodents are brownish above and white beneath, with a tawny stripe on the flanks dividing the dark from the light area. There is a very large number of species in both genera, some of those formerly included in *Heteromys* being now separated by American naturalists as *Liomys*, of which the type is *L. allenii*.



COMMON KANGAROO-RATS

JUMPING HARES

THE rodents included in the porcupine group comprise the whole of the remaining members of the order, with the exception of the hares, rabbits, and picas, and are distinguished from all those already described by the conformation of the lower jaw. In both the squirrel-like and mouse-like groups, the angular, or lower posterior process, of the lower jaw takes its origin from the inferior edge of the socket of the lower incisor teeth. In the present group, on the other hand, this process originates from a prominent ridge on the outer side of the jaw. With the exception of the jumping hares, the members of the group are also characterised by the stoutness of the zygomatic, or cheek, arch of the skull, and likewise by the bones of the lower leg—tibia and fibula—being distinct from one another.

The porcupine-like rodents, *Hystri-comorpha*, are very characteristic of America, and more especially of the southern half of that continent. Seven out of the eight families into which the group is divided occur, for instance, in America, while only three of them have any Old World representatives. Of the latter, the jumping hares and *Hystri-cidae* are confined to the Old World, where the *Octodontidae* are represented only in Africa, and chiefly in that part of the continent lying to the south of the Sahara. This, however, does not tell the whole story of the distribution of the group, for the American porcupines and the octodonts, exclusive of their African representatives, inhabited South America previous to its union with North America, which the Canadian porcupine entered after the union. These groups are, therefore, essentially southern, and the occurrence of octodonts in Africa is one of many pieces of evidence in favour of a former union of that continent with South America. With the exception of one species, these rodents have one pair of premolar teeth in each jaw.

The very remarkable South African rodent known as the jumping hare, or spring-haas (*Pedetes caffer*), was long regarded as an ally of the jerboas, but appears to be really a member of the porcupine-like group, in which it typifies a distinct family, the *Pedetidae*. From the jerboas this rodent is distinguished by the fact that in the neck the whole of the seven vertebrae are separate; the hind feet have four toes, and their

comparatively short metatarsal bones are not united together; while the cheek teeth, of which there are four on each side of the jaws, do not develop roots.

In size the jumping hare may be compared with the common hare, to which it also approximates in general colouring, the length of the head and body being about

24 inches, and that of the tail rather more. The head is relatively large, with long, pointed ears; the fore limbs are proportionately longer than in the jerboas, and the long tail is thickly haired throughout its extent. There are five toes, provided with long, sharp claws on the fore feet; while in the hind feet the claws are wider and blunter, and approximate somewhat to nails, the



THE JUMPING HARE

middle hind toe being much larger than any of the others. The long and soft hair of the upper parts is reddish brown, more or less mingled with white, but beneath the colour is pure white.

The range of the common jumping hare extends from the Cape to Angola on the west, and Mozambique on the east coast. In East Africa it is replaced by a smaller species known as *P. surdaster*. The habits of these rodents approximate very closely to those of the jerboas (page 571). They frequent, for instance, more or less desert districts, where they construct complex burrows, in which several families dwell together, and are thoroughly nocturnal. At the Cape they are found in considerable numbers, and frequent both the mountains and the open plains. When feeding, jumping hares go on all fours, but when at speed they progress with the leaps characteristic of jerboas. Ordinarily, the length of each spring is from 6 to 9 feet; but it is said that the leap may occasionally cover a space of as much as 20 or even 30 feet.

The young are born during the African summer, and are usually from three to four in number; during the rainy season young and old alike seldom stir from their burrows. The food appears to be entirely of a vegetable nature. The flesh is largely eaten by the Hottentots, who catch almost as many of these rodents as they please by the simple expedient of pouring water down their holes, when the owners immediately bolt.

THE OCTODONT TRIBE

As there is no collective English name for the various members of the extensive family of *Octodontidae*, we are compelled to adopt a modification of its Latin title. These rodents are more or less rat-like in form and characterised by having complete collar

bones, and the molars marked by enamel folds on both sides. In the skull the jugal portion of the cheek arch nearly always has an angle on its lower edge. The feet, which are armed with long curved claws, generally have five toes. The teats are placed high up on the

sides of the body ; the ears are short, and but thinly haired ; while the tail, which varies greatly in length, may be either clothed with short hair, or scaly. The family is confined to Africa on one side of the Atlantic, and to the West Indies and Central and South America on the other. According to modern naturalists, the living members of this family constitute no less than twenty-seven genera, although some of these are perhaps superfluous. There are also numerous extinct types.

GUNDIS

One of the most remarkable of the African representatives of the family is the gundi (*Ctenodactylus gundi*) from the regions bordering the Sahara, characterised by the two inner toes of the hind feet being furnished with a horny comb and bristles, which are employed in cleaning the fur. In size this rodent may be compared to a water rat with relatively long hind legs. It has no premolar teeth, the feet have only four toes each, the ears are small, and the tail is reduced to a mere stump. The gundi inhabits rocky districts and is diurnal, its mode of life being very similar to that of jerboas.

In Somaliland the gundi is replaced by the closely-allied Speke's gundi (*Pectinator spekei*), distinguished by its moderately long and bushy tail, and the presence of a small premolar tooth in each jaw. *Petromys typicus* of South Africa, formerly placed with the South American tucotucos, belongs here. The thumb is short, the fur coarse, and the tail bushy ; while the molars are partially rooted. A fourth generic type, *Massoutiera*, is represented by one species, *M. mzabi*, in Algeria, and a second, *M. vœ*, in Senegal.

Some naturalists put the cane-rats in this place, and separate this and the other African genera from the *Octodontidæ* as a separate family, *Ctenodactylidæ*. Such an arrangement, however, tends to obscure the intimate connection existing between the African and American forms, and is, therefore undesirable. The cane-rat is described below.

THE DEGU

The degu (*Octodon degus*), which is the typical representative of the entire family, is a species inhabiting Chile and Peru, and distinguished by the feet having five toes, without any comb-like appendages in the hind limb. The molar teeth are alike in both jaws, and simply indented on both sides by the folds of enamel. In general form the degu is like a rat, and slightly inferior in size to the water rat ; the length of the head and body varying from $7\frac{1}{2}$ to 8 inches, while the tail, exclusive of the tuft at the end, measures about 4 inches. The fur is remarkable for its softness, the ears are of moderate size, and the nearly naked tail terminates in a distinct tuft. The general colour of the fur on the upper parts is brownish yellow, mottled with black ; while the under parts are yellowish, and the feet white ; the tail being dusky above and whitish below, with the hair at the tip blackish.

Degus are some of the commonest rodents in Chile, and associate in large companies. They are found in hedges or bushes, and in the neighbourhood of towns may frequently be observed running across the high

roads ; while they often resort to gardens and orchards, where they commit considerable damage. Their burrows are constructed in hedge banks or under bushes, and those of the whole colony communicate more or less freely with one another. When disturbed, they scamper off with their tails raised over their backs, to seek refuge in their burrows. In many respects they resemble squirrels in their habits, climbing trees with facility, and laying up stores of food for winter use, although, owing to the mildness of the climate, they do not hibernate. Their food consists of the various plants growing round their burrows, supplemented in winter by bark. It is believed that two litters are produced annually, each containing five or six young.

Other species of *Octodon* inhabit Chile and Bolivia, and certain allied types from the Andes have been referred to the distinct genus *Octodontomys*. Chile is likewise the home of the two species of soft-furred degus forming the genus *Habrocoma*, so named from the extreme softness of the fur, which approaches that of the chinchilla. The soft-furred degus, of which one is known as *H. bennetti* and the other as *H. cuvieri*, are about the size of ordinary rats, and distinguished by their large ears, the absence of a tuft to the tail, and by the lower molar teeth being more complex than the upper ones. Another allied rodent from the southern Andes known as *Aconemys fuscus* is distinguished by the enamel folds of the molars meeting in the middle line. The regions where these rodents are found are buried in snow for several months of the year.

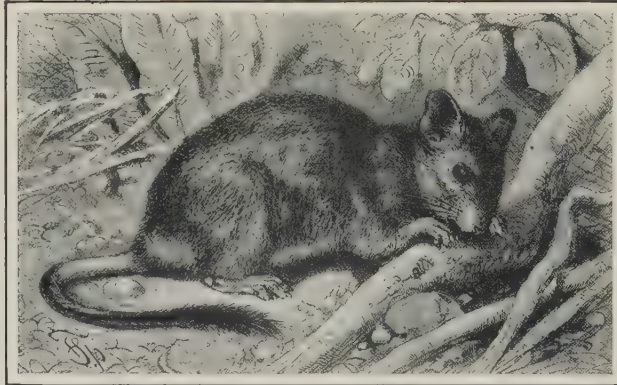
TUCOTUCOS

The tucotucos, of which there are several South American species, are characterised by their adaptation for a subterranean life. They have small and almost rudimentary ears, minute eyes, and short tails. Their incisor teeth are extremely

broad, and their molars are rootless, with kidney-shaped crowns. On the fore feet the curved claws are longer than the toes ; while the hind toes are furnished with a number of bristles. The species of tucotuco vary in length from 8 to 12 inches, exclusive of the tail, which is about one-fourth as long again ; and the general colour of the soft fur is greyish, while the incisor teeth are red.

The range of this genus of rodents extends from Brazil and Bolivia to the Strait of Magellan. The name tucotuco is derived from the peculiar cry of these animals, which, from their subterranean habits, are also termed *oculto*. In many districts, especially where the soil is sandy, these rodents are found in large numbers ; whole tracts being frequently undermined by their long and shallow burrows, of which the course is indicated by lines of hillocks. They are nocturnal in their habits, feeding mainly upon the roots of plants, of which they are said to lay up a store.

Mr. W. H. Hudson writes that on the Argentine pampas wherever there is a stretch of sandy soil, or a range of sandhills, the tucotuco (*Ctenomys magellanicus*) is to be found ; " not seen, but heard ; for all day long and all night sounds its voice, resonant and loud, like a succession of blows from a hammer ; as if a company of gnomes were toiling far down underfoot, beating on their anvils, first with strong, measured strokes,



THE DEGU

then with lighter and faster, and with a swing and rhythm as if the little men were beating in time to some rude chant unheard above the surface." The tucotucos are somewhat gregarious in their habits, as several may be often taken from a single burrow.

Chile is the home of another rodent known as the cururo (*Spalacopus pæppigi*), nearly allied to the last, but distinguished by its rudimentary ears.

THE COYPU

Widely different in its habits from the tucotuco is the coypu (*Myocastor*, or *Myopotamus, coypus*) of South America, which is one of the largest members of the order, attaining a length of from 20 inches to 2 feet, exclusive of the tail. It belongs to a group of several genera distinguished from the preceding American species by the very harsh nature of the fur, and the depth of the folds of enamel in the half-rooted or rootless molars.

The coypu itself is characterised by the very large size of its incisor teeth; and by the upper molars having two folds of enamel on each side, while in those of the lower jaw there are one external and three internal folds. The molars are partially rooted, and the last one is larger than either of the others. The ears are of moderate size; and the tail, which is scaly, with a thin coating of short hairs, is about two-thirds the length of the head and body. Each of the feet has five toes, which in the hind limb are connected by webs. The fur of the coypu is long, but beneath there is a dense and soft under fur. The colour of the upper parts is a mixture of dusky and brownish yellow, the sides and under parts being pure brownish yellow, the tip of the muzzle and chin white, the feet dusky brown, and a patch below each ear yellow. The teats of the female are placed higher up on the sides of the body than in any other mammal.

The coypu is found in the rivers and lakes of South America, on both sides of the Andes, from Chile and Peru to about 48° S. In the Chonos Archipelago, according to Darwin, coypus are found exclusively in the channels and bays separating the small islands.

In appearance and habits the coypu is not unlike a beaver, being thoroughly aquatic, and making its burrow in the banks of the rivers and lakes it frequents. When, however, the banks are not sufficiently high to allow of this, a platform-like nest is constructed among the reeds. The burrow is 3 or 4 feet in depth, and expands at the end into a chamber of some 2 feet in diameter. Coypus are generally found in pairs, but in Argentina I have seen them coming out in large parties in the evenings to swim and sport in the water. Here they utter peculiarly mournful cries; the females, at the proper season, being each accompanied by some eight or nine offspring,

which endeavour to obtain a seat on their parent's back, those that are unable to attain this position of security swimming behind.

Although a first-rate swimmer, the coypu is said not to be an adept at diving; and its movements on land are always awkward and ungainly. These rodents usually select for their haunts the stillest parts of the rivers, lakes, or ponds; and their food consists of the foliage, seeds, and roots of the water plants growing hard by. In the Chonos Archipelago, where they make their burrows in the forest at some distance from the shore, they are said to subsist partly on molluscs.

In Argentina Mr. W. H. Hudson states that at one time coypus became very scarce owing to the numbers killed for their fur. An enactment was then passed forbidding the killing of these animals; the result being that they "increased and multiplied exceedingly, and, abandoning their aquatic habits, became terrestrial and migratory, and swarmed everywhere in search of food. Suddenly a mysterious malady fell on them, from which they perished and became almost extinct."

The under fur of the coypu is an important article of commerce, the average number of skins annually collected varying from three hundred thousand to five hundred thousand. In Argentina the coypu is known as nutria, the Spanish name for the otter; the same term being applied in commerce to the fur of this rodent.

HUTIAS

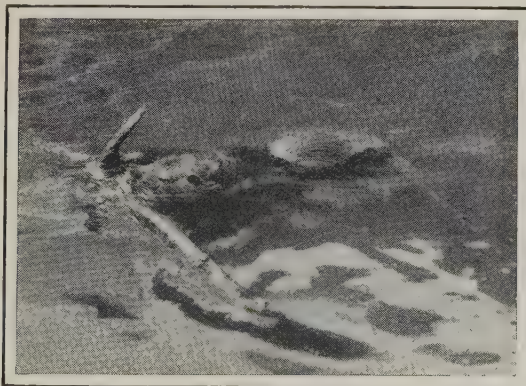
The large rodent known as the hutia couga (*Capromys pilorides*) is one of a group of several species confined to the West Indies (where they are the only indigenous rodents), though they are also represented in South America. They are allied to the coypu, but distinguished by their arboreal habits and more rat-like appearance, as well as by certain structural peculiarities. The incisor teeth, for instance, are narrower than in the coypu, while the upper molars are characterised by one fold of enamel on the inner side, and two on the outer side. The ear is relatively small, and the tail of considerable length, thick, and sparsely haired.

The hutia couga is confined to Cuba, and is somewhat smaller than the coypu, the length of the head and body being about 22 inches. The fur is very long and coarse, its general colour being a mixture of yellowish grey and brown, becoming reddish brown on the back and loins, while beneath it is dusky brownish grey, with a more or less marked yellow tinge. The paws are black, the ears dark, and the chest and a streak down the middle of the belly grey. Internally this species is remarkable in that the liver is split up into a number of small lobules.

Another Cuban species is the hutia carabali (*C.*



A GROUP OF COYPUS



A COYPU SWIMMING

prehensilis), distinguished, among other characters, by the tip of the tail being prehensile. In Jamaica there is the short-tailed hutia (*C. brachyurus*), while in the Bahamas the genus is represented by Ingraham's hutia (*C. ingrahami*). The South American *Procapromys geayi* inhabits Venezuela, and represents a genus by itself.

The hutia couga inhabits dense forests, and is an expert climber, ascending trees both to avoid pursuit and in search of food. It subsists mainly on fruits, leaves, and bark, but also eats the flesh of small animals, particularly that of a kind of lizard. This species can be easily tamed; and its flesh is considered a delicacy by the natives of Cuba, who either hunt the creature with dogs or capture it by means of snares. The smaller hutia carabali is said to confine itself to the most remote districts of the forests, and to frequent the topmost branches of the trees. It is more shy and less easily tamed than the hutia couga, but, like the latter, fights fiercely in self-defence when attacked.

In one of the species, at least, there are only four teats in the female, from which it may be inferred that the number of young in a litter is small. The nipples, as in the coypu, are situated high up on the sides of the body; and this seems to disprove the suggestion that in the latter animal they are thus situated in order that the young may be able to suckle while the parent is in the water. In Hayti and Jamaica the hutias are also represented by a nearly-allied rodent known as *Plagiodon cedium*, distinguished by the extreme complexity of the enamel folds of the molar teeth, which in the upper jaw form a kind of zigzag pattern.

CANE-RATS

The African cane-rat (*Aulacodus*, or *Thryonomys swinderianus*), which has been regarded as allied to

appearance is rat-like, with the fur very coarse, and the tail but sparsely haired. In the fore feet the thumb is rudimentary and the fifth toe small; while in the hind foot the first toe is entirely wanting. The colour of the fur is brown, richer in tint on the back than on the flanks; the chin and upper lip being



THE HUTIA COUGA

whitish, while the throat is a dirty yellow, and the under parts are a pale brownish yellow. The feet are pencilled with black and yellow. A full-grown male will weigh as much as 9 or 10 pounds. It is a native of Western and Southern Africa, and is represented by other species in the central and eastern districts of the continent.

The range of the genus thus extends from the Upper Nile, where it is represented by a species with partially-webbed hind feet, through Eastern and Central Africa to the Cape; while on the western side it reaches as far north as Guinea. In Guinea the cane-rat is known to the natives as the yumba, while in South-Eastern Africa it is termed the ivondue. In Sierra Leone it is said to feed chiefly upon ground-nuts and roots, in search of which it digs into the soil, but it also forms burrows for its residence.

In South-Eastern Africa the habits of these rodents are somewhat different. For instance, the Hon. W. H. Drummond states that cane-rats "do not form burrows of their own; but when forced out of the thick tangle of overgrown grass or reeds in which they lie, a task by no means easy of accomplishment, they take refuge in any hole or crevice among rocks or stones, or in the deserted burrows of the ant-eater or porcupine. They are not only destructive to a degree among sugar-canes, gnawing down stem after stem, but most difficult to extirpate. In spots such as these they live in what fields happen to be lying fallow, which, being covered with an impenetrable thicket of grass and weeds, offer them a secure retreat from which they can nightly issue forth into the canes."

Cane-rats are largely hunted by the natives, and in some cases by Europeans, for the sake of their flesh; Dr. Schweinfurth remarking that the flesh "is excellent when roasted; it is rich, and without being sweet and insipid like that of the hyrax, is free from any unpleasant flavour. In quality it is about equal to poultry, whilst in taste it may be described as being intermediate between pork and veal."



THE CANE-RAT

the coypu, although many naturalists now place it near the gundi, is a large species of burrowing habits, easily recognised by three deep grooves on each of the broad red upper incisor teeth. The molar teeth resemble those of the hutias. The cane-rat attains a length of about 21 inches to the root of the tail; the tail measuring from $5\frac{1}{2}$ to $8\frac{1}{2}$ inches. Its

THE CANADIAN PORCUPINE

There are numerous other South American representatives of the octodonts, which are for the most part rat-like species with long, cylindrical tails, and many of them remarkable for the intermixture of flattened lance-like spines with the fur. Some of the best-known genera are *Loncheres* and *Echinomys*, or *Echimy*s, the members of which are mostly characterised by the possession of the above-mentioned spines.

The majority of the species of these two genera inhabit Guiana and Brazil, but one species of *Echinomys*

ranges into Central America. Most of these rodents are brown above and white beneath, but in some cases the white extends on to the flanks, shoulders, and head, thus giving them somewhat the appearance of long-tailed guineapigs. A third genus, *Carterodon*, of which there is but one Brazilian species, *C. sulcidens*, is distinguished by a longitudinal groove on each upper incisor; while *Dactylomys dactylinus* of Ecuador and *D. peruanus* of Peru represent yet another type.

AMERICAN PORCUPINES

Porcupines, which are distinguished from their allies by the presence of a number of large quill-like spines in the skin, are stoutly-built rodents, with the fore and hind limbs of subequal length. In the skull the region of the face is comparatively short and broad, while the cheek, or jugal, bone in the zygomatic arch is devoid of the angle on its lower edge distinctive of most of the members of the preceding family. The molar teeth are partly or completely rooted, with folds of enamel on each side.

Porcupines derive their name from the French *porc épin* (spiny pig), probably owing to their grunting, pig-like cries; they are common to both the Old and New Worlds, but there is a marked distinction—now regarded of family value—between the western and eastern forms, the former constituting the family *Erethizontidae*. All the American porcupines are, for instance, arboreal in their habits, while most of them have prehensile tails. They are all characterised by the absence of a cleft in the upper lip, by the naked soles of the feet being covered by a number of tubercles, by the want of the first toe in the fore foot, and the presence of only three teats in the female. Their molar teeth have complete roots; and the collar-bones are fully developed.

THE CANADIAN PORCUPINE

The common Canadian porcupine (*Erethizon dorsatus*), with its various local races, differs from all the other members of the family in having a short and non-prehensile tail, and also in the presence of five toes on the hind feet. It is a heavy and clumsily-built rodent, with long, brown hair, almost or completely concealing the short spines, which are white with brownish tips. The length of the creature is about 2 feet, and its weight from 15 to 20 pounds. The limbs, neck, ears, and muzzle are short; the ears being almost concealed by the long bristly hair at the sides of the head. The claws are very long and powerful; and the tail massive and almost four-sided in shape.

The stout spines vary in length from less than one inch to more than four inches in different parts of the body; they cling loosely to the skin, and are thus easily detached, and as they are slightly barbed at the points they make their way completely through the flesh of any animal in which they may become fixed. As in other members of the family, the quills, when the animal is in repose, lie smoothly and are directed backwards; but under the influence of excitement they can be erected by the aid of a sheet of muscle underlying the skin.

The Canadian porcupine extends in the country from which it takes its name as far northwards as the limit

of trees, while in the United States it ranges on the eastern side as far south as Virginia, and on the western coast from Alaska to Arizona and New Mexico. Despite its heavy form and nonprehensile tail, it is an adept at climbing, and spends the greater part of its time among the branches of trees. Although largely nocturnal, these rodents may at times be seen abroad during daylight. Their lair is usually made among the clefts of rocks, but sometimes in a hollow tree or heap of bushes.

Even in the cold climate of the Adirondacks this porcupine, although less active in the winter, never hibernates. Dr. C. H. Merriam writes that when one of these rodents "has selected and settled himself in a tree to his liking, he may not leave it, day or night, until he has denuded it of the whole of its foliage. I have seen many hemlocks thus completely stripped, not a green twig remaining even on the smallest bough. It seems incredible that so large and clumsy an animal should be able to climb out far enough on the branches of trees to reach the terminal leaves; but he distributes his weight by bringing several branches together, and then, with his powerful paws, bends back their ends and passes them through his mouth. When high in the tree tops he is often passed unnoticed, mistaken, if seen at all, for the nest of a crow or a hawk."

The food of this porcupine consists not only of the leaves of various trees—especially the hemlock spruce—but likewise of their twigs and bark; while beech-mast



THE CANADIAN PORCUPINE

is also a favourite article of diet. The pods of water-lilies are likewise eaten, and a partiality for salt is very marked. The nest is constructed in the same situation as the sleeping lair. The young in the Adirondack region are born early in May, and are usually one or

two in number. At birth they are very large for the size of the animal, being actually larger, and proportionately more than thirty times the size of the cubs of the black bear. This porcupine uses its tail as a weapon of offence, inflicting severe blows by its lateral action. Few mammals care to attack the porcupine, although, as previously mentioned, both the puma and fisher marten make these animals their prey, and are frequently found with their flesh bristling with quills (pages 393 and 506).

TREE PORCUPINES

The South American tree porcupines (genus *Syntheres*, or *Coendua*), are distinguished from the Canadian

porcupine by their long, prehensile tails, and the presence of only four toes on the hind feet. They are also of lighter build, and their spines are short, closely set, and parti-coloured, being sometimes almost concealed by long hairs. In the absence of the first toe, the inner side of each hind foot is furnished with a large, fleshy lobe, which can be bent inwards to a certain degree, and forms an efficient aid in climbing; more especially as the whole foot is set so obliquely on the leg that the rough sole is directed somewhat outwardly. The tail is thick at the base, but slender at the end, where its upper surface is devoid of hair. It is this upper surface which is applied to the branch, and the tail is, therefore, coiled in the reverse direction to that of the spider monkeys (page 254).

The muzzle is thick with large nostrils, and obliquely truncated, so that the upper lip somewhat overhangs the lower portion; the whole being clothed with fine, velvety hair. Both the ears and eyes are small. The quills have numerous exceedingly minute spines at their extremities, with their points directed backwards, so as to act as barbs. All these rodents exhale a strong fetid odour.

The Brazilian tree porcupine (*S. prehensilis*), the species commonly seen in menageries, inhabits Brazil, Guiana, and part of Bolivia, and has the spines projecting freely above the fur. In length the head and body measure from 16 to 18 inches, the tail being about an inch shorter. These rodents, like the other species of the genus, are usually solitary, passing the greater part of the day in slumber, and feeding in the morning

and evening. Their food consists of the leaves, young shoots, and bark of the trees on which they dwell. In climbing it is said that they ascend the trunk of trees by the feet alone, the tail being employed only when among the smaller branches, which these rodents seldom leave. When sleeping, they generally rest in the fork of a branch. Comparatively little is known of their habits in a wild state, but in captivity they are harmless, stupid creatures. Their flesh is eaten by the natives of Brazil, who call them *cuanu*.

The Mexican tree porcupine (*S. novæ-hispaniæ*) belongs to a group which has the hair so long as almost to conceal the spines, and is further distinguished by the nearly uniform black colour of the fur, and also

by the presence of numerous spiny bristles mingled with the hair of the lower parts of the body. These bristles arise in small clusters from tubercles, and being white for the greater part of their length form star-like spots among the dark fur. Like the spines on the back, they are black at the tips.

This species inhabits the forests on the eastern coast of Mexico. Nothing special is recorded of its habits, but it may be mentioned here that from observations made on captive individuals of other species, it is probable that none of the tree porcupines ever drinks. It is stated that in those long-haired species in which the fur is of a greyish tint the general appearance of the animal when reposing on the arm of a tree closely simulates a gnarled and lichen-clad knot.

THIN-SPINED PORCUPINE

A peculiar porcupine (*Chatomys subspinosus*) from

Central and Northern Brazil differs from all the members of the preceding genus by the shape of its skull and the more complicated structure of its molar teeth, as well as by the slenderness of its spines, which may be described as half-way between those of the other groups and mere bristles. It is a large species, of a dull brown colour, with the under parts inclining to rufous, and the feet and tail brownish black. The tail, although long, is not prehensile; and the habits of the animal are less completely arboreal than those of the preceding group.

Remains of a species of *Erethizon* occur in the superficial deposits of Pennsylvania, and those of *Syntheres* in the caverns of Brazil



BRAZILIAN TREE PORCUPINE

OLD WORLD PORCUPINES

THE true porcupines (family *Hystrioidæ*), as typically represented by the common South European species, are confined to the Old World, and differ from their transatlantic cousins by the following characteristics. Externally the soles of the feet are perfectly smooth, the fore feet have a small thumb, and the female is provided with six teats. In the skeleton the collar-bones are incomplete, and the molar teeth have imperfect roots. In habits all these porcupines are purely nocturnal and terrestrial, and consequently the tail is never prehensile.

TYPICAL PORCUPINES

The European, or true, porcupine (*Hystrix cristata*), like the other members of the same genus, is characterised by its massive form, large size, the great length of the quills on the body, and the short, spiny tail terminating in a cluster of short slender-stalked quills, which are hollow and open at their extremities, the tail quills making the peculiar rattling noise noticeable when a porcupine is in motion (page 521). The genus is further characterised by the great elevation and convexity of the skull, in which the chamber of the nose is frequently more capacious than the brain case.

Next to the beaver, the porcupines are the largest of the Old World rodents, the European species measuring from 26 to 28 inches in length, exclusive of the tail. The prevailing colour of this species is brownish black, with a white band crossing the front of the neck and extending about half-way up the sides, when it becomes gradually narrow. The neck is furnished with a crest of long bristles, which are mostly brown at the base and white above. The quills on the body are of two kinds—the one distinguished by their great length, slenderness, and flexibility, while the others are shorter and stouter, and in great degree concealed by the larger ones.

These quills are mostly marked with broad rings of black and white, both extremities being of the latter hue. Those on the rump, however, are chiefly black, while the open quills at the end of the tail, as well as most of those clothing the rest of that appendage, are entirely white. This porcupine inhabits Southern Europe and Northern and Western Africa.

In India the European species is replaced by the closely allied hairy-nosed porcupine (*H. leucura*), distinguished by the muzzle being densely clad with hairs, as well as by the quills at the base of the tail, and sometimes a row in the middle of the hind part of the back, being mostly white. The skull, moreover, is less convex, with smaller nasal bones. This species is found from Ceylon to Kashmir, and appears to extend westwards as far as the Black Sea.

Two other species inhabit India, of which the Bengal porcupine (*H. bengalensis*) has a much shorter crest

on the neck, while in Hodgson's porcupine (*H. longicaudata*) this crest is totally wanting; the latter occurs in the Eastern Himalaya. The South African porcupine (*H. afræ-australis*) is a third representative of the crested group.

Remains of fossil porcupines occur in the Pliocene rocks of Northern India, and also in the upper and middle Tertiaries of Europe.

As the habits of all the true porcupines appear to be very similar, they may be treated collectively. In the first place, it should be mentioned that the old idea of porcupines being able to eject their quills at an enemy is a pure fable: the quills of the tail really form a kind of rattle to warn other animals of the approach of a dangerous creature. Although a belated individual may occasionally be seen making its way homeward in the early morning, porcupines remain concealed during the daylight hours, either in caves or clefts of rocks, or in burrows excavated by themselves. They prefer rocky hills, and, although in Europe usually found either solitary or in pairs, in India they are frequently gregarious. Their food is entirely vegetable, and consists mainly of roots, although in cultivated districts porcupines do much damage to crops, garden vegetables, and such fruit as they can reach.

In Europe the pairing season takes place early in the year, and in the spring or beginning of the summer the female produces from two to four young, in a nest formed of leaves, grass, and root fibres. The young are born in an advanced state, having their eyes open, and their bodies covered with soft flexible spines, which soon harden by exposure to the air. When frightened or irritated, porcupines erect their quills, with a peculiar rattling of the hollow ones at the tip of the tail, at the same time stamping with their hind feet. If attacked by dogs or other four-footed foes, they rush backwards and inflict severe wounds with the long quills on their hind

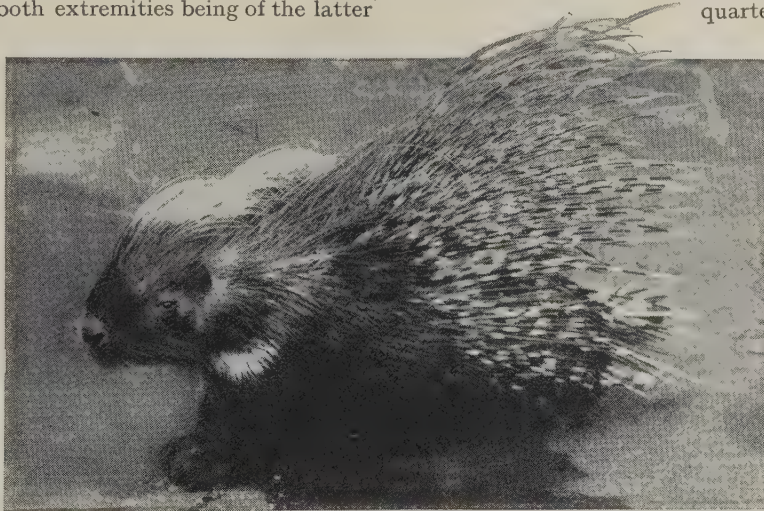
quarters, the quills being sometimes driven deeply into the flesh of their antagonists.

Dogs readily follow the scent of porcupines, and thus track them to their lairs. Leopards are said to despatch them easily by a single well-directed blow on the head. From the large size of their teeth and jaws, porcupines have great gnawing powers, and in India I have seen tusks of elephants which have been eaten by these rodents as they lay in the jungles. The flesh of

porcupines is excellent eating, and said to resemble something between pork and veal in flavour.

MALAY PORCUPINES

The large Malay and Javan porcupines commonly known as *Hystrix brachyura* and *H. javanica* are referred by some naturalists to the separate genus *Acanthion*. These porcupines differ from the typical



THE PORCUPINE
(Photograph, Illustrations Bureau)

Hystrix in the absence of a nuchal crest, the shorter quills, and much shorter nasal bones in the skull, which extend backwards only so far as the line of the lachrymals, instead of to the hind root of the zygomatic arch.

A species from Sumatra has been made the type of another genus, *Thecurus*, differing from *Acanthion* in the smaller capsule-like extremities of the tail bristles, often closed at the end, and the smaller quills, which are replaced on the lower part of the rump by grooved spines like those on the back. The full name of this species is *Thecurus sumatrae*.

BRUSH-TAILED PORCUPINES

The West African brush-tailed porcupine (*Atherura africana*) is the typical representative of a genus with several West and Central African species (or races), and an outlying one (*A. macrura*) in Burma and the Malay region. They are much smaller and more rat-like rodents than the true porcupines, from which they are distinguished by their long and scaly tails terminating in a tuft of bristles.

The body is covered with flattened and grooved spines, which are not much longer on the hind quarters than on the back and shoulders. In the Malay species the length of the head and body may reach as much as 22 inches, that

of the tail being about 10 inches. In colour this species is dark brown, with the tips of the spines sometimes paler. The longer spines on the hind quarters are mostly white, the under parts and the bristles at the end of the tail being whitish.

BORNEAN PORCUPINE

A rare porcupine from Borneo (*Trichys guentheri*) differs so markedly from the preceding in the characters of its skull that it is regarded as indicating a separate genus of the family; being distinguished externally from the brush-tailed porcupines by its shorter spines, and the

narrow, parallel-sided bristles of the tail.

Up to the year 1889 only four specimens of this porcupine had been received in England, although there are others in the Museum at Leiden. The first of these had lost its tail, and was described as a new species, under the name of *T. lipura*—a designation which is therefore inapplicable to a normally long-tailed rodent, although by some modern naturalists it



WEST AFRICAN BRUSH-TAILED PORCUPINE

would be retained. Some naturalists, again, call it *Trichys fasciculata*, while others hold that the specific name was originally applied to the brush-tailed porcupine.

THE CHINCHILLA TRIBE

THE remaining rodents of the porcupine-like group are confined to South and Central America and the West Indies; those included in the family *Chinchillidae* being few in number and characterised by their terrestrial habits, elongated hind limbs, long bushy tails, and extremely soft fur. Internally, they have complete clavicles; their molar teeth are divided into a series of parallel transverse plates by the extension of the folds of enamel completely across their crowns, and the incisors are remarkable for their shortness. In the skull the palate is very narrow in front, while behind it remains unossified for a considerable distance in advance of the last molar teeth.

CHINCHILLAS

The chinchilla (*Chinchilla lanigera*), so highly valued on account of its lovely French grey fur, is the typical representative of a group of rodents characterised by having four toes on the hind feet and five on the fore feet, by the length of the bushy tail, and also by the enormous size of the bullæ of the internal ear on the base of the skull, which are so much enlarged as to appear on the sides of its upper surface.

The common chinchilla is a squirrel-like rodent with very large ears, and a tail about half the length of the head and body; the latter measuring 10 inches.

The fur, which is about an inch in length, is of extreme softness, and of a delicate pearly grey, mottled with black above and yellowish white beneath, while the tail is mostly black, with lighter bands on the sides. The front surfaces of the incisor teeth are of a bright orange.

This species inhabits the higher Andes, from the south of Chile to the north of Bolivia, and in certain districts is very abundant. Chinchillas live in burrows, where they associate in large companies, and may frequently be seen abroad during the daytime, keeping, however, to the shade thrown by the rocks. On the ground they run much after the fashion of mice, but when feeding they sit up on their hind quarters in a squirrel-like manner, and grasp their food between the fore paws.

The regions which these rodents inhabit are lonely and barren, with a very small amount of vegetation. In such places there are numerous perpendicular faces of rock, up and down which these tiny creatures dart with such lightning-like rapidity as to render it almost impossible for the eye to follow them. Although by no means shy, the report of a gun is sufficient to send them at once to their holes, and a spot which at one moment may be seen covered with hundreds of these rodents

THE VISCACHA

will be left deserted in an instant. The natives hunt them with the aid of a species of weasel, which enters their burrows. From its peculiar softness and delicacy, the fur has long been highly appreciated in Europe, large quantities being imported.

SHORT-TAILED CHINCHILLA

The short-tailed chinchilla (*C. brevicaudata*), from Peru and Bolivia, is decidedly larger than the common chinchilla, with relatively shorter ears and tail. The general colour of the fur of the upper parts is very pale bluish grey, mottled with slaty black, the under surface of the body, as well as the feet, being white. The tail gradually becomes bushy towards the tip; its fur being a mixture of greyish white and greyish black, becoming darker towards the tip on the upper surface.

CUVIER'S CHINCHILLA

Cuvier's chinchilla (*Lagidium peruanum*) and the allied *L. pallipes* of Bolivia and Northern Peru are larger rodents than the preceding, the length of the head and body in the species first named varying from about 16 to 20 inches, and that of the tail, exclusive of the hair at the tip, from 11 to 12 inches; and since they differ by having only four toes on each foot, they are considered to represent a distinct genus. The ears are longer and more pointed than in the true chinchillas, while in the skull the bullæ of the internal ear are relatively smaller. The hue of the long and soft fur is ashy grey, tinged with yellow and pencilled with black; but on the under parts it is pale yellow, gradually becoming deeper on the flanks. The feet are grey, and the tail is black below, with very long hairs above, some of which are also of the same jetty tint. One of the most remarkable features about the animal is the length of the black whiskers, in which some of the hairs may measure as much as 7 inches.

Cuvier's chinchilla is an inhabitant of the higher Andes of Chile, Peru, and Bolivia, ranging to elevations of some sixteen thousand feet above the sea-level. In habits these rodents seem to be almost identical with the true chinchillas, dwelling in barren, rocky districts, and exhibiting similar marvellous activity. Their food is composed of grass, roots, and moss, to procure which they have frequently to travel long distances from their homes. Their principal enemies are the condor and the dogs of the shepherds. They are captured by the Indians in snares for the sake of their fur, which is, however, far less valuable than that of the chinchilla.

VISCACHA

The single representative of the third generic modification of the present family differs from its cousins in being an inhabitant of the open pampas, ranging from

the Rio Negro to the Uruguay River, instead of the heights of the Andes. Viscachas (page 131) are primarily distinguished from the chinchilla group by the toes of the hind feet being reduced to three in number; while the claws on these feet, and, to a less degree, those of the fore feet also, are relatively longer. The cheek teeth, with the exception of the last in the upper jaw, are distinguished by having only two transverse plates of enamel, and by their squarer form.

In its stoutly-built body and sturdy limbs the viscacha (*Lagostomus*, or *Viscacia*, *trichodactylus*) presents a contrast to the delicately-formed chinchillas exactly similar to that existing between squirrels and marmots; this difference in form being accompanied by a precisely similar difference in habits, the viscachas being purely burrowing rodents.

In the viscacha the length of the head and body varies from some 19 to 23 inches; that of the tail being about a third as much again. The ears are rather small, and distinctly notched behind, the tail is bushy throughout the greater part of its length, and the fur is rather short. The colouring of the fur is somewhat striking. Above the hue is grey, with some dusky mottlings and black markings, while the whole of the under parts are white or yellowish white. From the muzzle a blackish band extends across each cheek, above which is a broad white stripe terminating in front of the eyes, and a third narrower dusky band crosses the lower part of the forehead. The tail is blackish brown.

The viscacha is by far the most common rodent on the Argentine pampas, and an excellent account of its habits is given by Mr. W. H. Hudson, from which the following summary is compiled. These rodents live

in societies usually numbering from twenty to thirty individuals, and form warrens known as *viscacheras*, each of which may contain from twelve to fifteen burrows, some double or triple. Such a viscachera will cover from one to two hundred square feet of ground. The burrows vary much in extent; some opening out into wide chambers, from which tunnels radiate; while others communicate with their neighbours. The whole viscachera forms a raised mound of earth that has been brought up from the burrows. It is always made on the



THE CHINCHILLA

open plains, and the entrances to some of the compound burrows are sometimes as much as a yard in diameter. Usually the burrow takes the form of the letter Y.

A passerine bird (*Geositta*), belonging to the wood-hewer family, makes its breeding holes in the sides of the viscacha burrows; but, when deserted by their rightful owners, they are occupied by a kind of swallow (*Atticora*). Moreover, on the mound of the viscachera may frequently be observed a pair of burrowing owls

(*Speotito*), which excavate a domicile for themselves, but sometimes occupy one of the burrows on the flanks of the mound. The whole of the ground in the neighbourhood of the burrows is carefully cleared of all vegetation, the refuse of which is heaped up near the entrance, and it is this habit which renders these animals so obnoxious to the farmer. The usual food of viscachas is grass and seeds, but they sometimes also eat roots; while in the dry season they are reduced to withered grass and thistles. When the herbage is green, viscachas require no water, but the first shower in the dry season brings them at once out of their holes to imbibe the much-needed fluid.

Viscachas are essentially nocturnal. Mr. Hudson states that in winter they "seldom leave their burrows till dark, but in summer come out before sunset; and the viscachera is then a truly interesting spectacle. Usually one of the old males first appears, and sits on some prominent place on the mound, apparently in no haste to begin his evening meal. When approached from the front he stirs not, but eyes the intruder with a bold, indifferent stare. If the person passes to one side, he deigns not to turn his head.

"Other viscachas soon begin to appear, each one quietly taking up its station at the burrow's mouth, the females, known by their greatly inferior size and lighter grey colour, sitting upright on their haunches, as if to command a better view, and indicating by divers sounds and gestures that fear and curiosity struggle in them for the mastery. With eyes fixed on the intruder at intervals they nod the head, emitting at the

same time an internal note with great vehemence; and, suddenly, as the danger comes nearer, they plunge simultaneously, with a startled cry, into their burrows. When driven to the recesses of their burrows, they utter a peculiar kind of growling sound."

The viscacha is far from prolific, the female producing in September a single litter, which usually contains two, but occasionally three young. As these rodents take about two years in reaching maturity, the vast numbers in which they existed on the pampas before the war of extermination waged against them by the agriculturists is not a little remarkable.

The habit of accumulating the remains of its food around the entrance of its burrow has been already mentioned; but, in addition, the viscacha collects every hard object with which it meets. Darwin writes that "around each group of holes many bones of cattle, stones, thistle stalks, hard clumps of earth, and so forth, are collected into a heap, which frequently amounts to as much as a wheelbarrow would contain. I was credibly informed that a gentleman, when riding one dark night, dropped his watch; he returned in the morning, and by searching in the neighbourhood of every viscacha hole on the line of road, as he expected, soon found it."

Remains belonging to the same genus as the viscacha are met with in the superficial deposits of South America, while in the older formations there occur those of allied extinct genera. One of these extinct rodents (*Megamys*) was the largest member of the order, its size approaching that of an ox.

THE AGUTI TRIBE

THE South American rodents respectively known by the names of aguti and paca constitute a small family (*Dasyproctidae*) with the following characteristics. The limbs are of nearly equal length and furnished with hoof-like claws; the tail is short or wanting; the molar teeth have imperfect roots, and enamel folds on both sides of the crowns; and the incisor teeth are long. In the skeleton the collar-bones are rudimentary, the palate is broad, and the lower jaw lacks the distinct ridge on the outer side characteristic of the preceding families.

Agutis are elegantly-formed rodents with a superficial resemblance to the chevrotains among the ungulates, and characterised by their long and slender limbs and the presence of only three toes on the hind feet, the fore feet, however, having the full number of digits. The hair is coarse, more especially on the hind quarters, where it becomes longer than elsewhere. The crowns of the molar teeth are rounded, and when worn exhibit a single lateral fold of enamel, with several islands of the same on their summits. There are several species of aguti inhabiting the greater part of Central and South America as far as Paraguay, and there is another in the West Indies.

THE COMMON AGUTI

The common aguti (*Dasyprocta aguti*) may be taken as the typical example of the genus, all the members of which are very similar to one another in form and

habits. This species, which occurs abundantly in the dense forests of Guiana, Brazil, and Northern Peru, attains a length of from 18 to 20 inches, and is of an olive-brown colour. The middle line of the under surface of the body, however, is yellow or whitish, while the long hairs of the hind quarters are mostly of a bright orange tint. The feet are pencilled with black and yellow, and the toes are dusky.

The large ears are pinkish, except on their margins, and the small fleshy tail is naked and of a dusky hue.

Although essentially forest-dwelling animals, agutis are sometimes seen in the early morning or evening on the open spaces. They are mainly nocturnal, remaining concealed during the day in hollow trees or in cavities or burrows among their roots, such burrows being in some cases two or three feet in depth. Their movements are extremely active and graceful. When going slowly they advance at a kind of trot, but when running their pace takes the form of a series of rapid springs, which succeed each other so quickly as to give the appearance of a gallop.

Cutias, as these animals are called on the Amazon, can swim well, but are unable to dive. Their food consists of the foliage and roots of ferns and other plants, as well as fallen fruits, their sharp incisor teeth enabling them to perforate the shells of the hardest nuts. In cultivated districts they do much harm to plantations of sugar-cane and bananas. Of their reproduction in a wild state comparatively little is



AN AGUTI

known. They breed, however, at least twice in the year—generally in May, before the beginning of the period of drought, and again in October, at the setting in of the rainy season. In captivity, where these rodents not infrequently breed, there are usually only one or two at a birth, but in a wild state the number may be greater.

For a considerable portion of the year the two sexes remain apart; but at the pairing season each male selects a female, which he follows with squeaks and grunts, and with which he remains until after the birth of their offspring. The female brings forth her young in a lair, or nest, carefully formed of leaves, roots, and hair, and attends them sedulously for some weeks, preventing the male from having any access to them until some days after birth.

When first born, the young closely resemble their parents.

If captured at a sufficiently early age, agutis can be readily tamed, and it is not uncommon in South American houses to find one or more of these animals roaming at large. The nocturnal foes of agutis are ocelots and other species of cats, and also the Brazilian wolf. They are much hunted by the natives for the sake of their flesh. On the Amazon they are hunted with dogs, one hunter proceeding in the early morning to beat the forest in the neighbourhood of a river, while his companion takes his station in a boat. On being hard pressed by the dogs, the agutis make for the water, where they are shot by the man in waiting.

THE AGUCHI

The only other member of the genus to which reference need be made is the aguchi (*D. cristata*), which inhabits Northern Brazil and Guiana, as well as parts of the West Indies. This species is distinguished from the others by its smaller size and longer and more slender tail, which is clothed with silver-white hairs. Its general colour is rich chestnut-brown, with a characteristic bright golden yellow, or rust-coloured patch behind each ear.

Fossil remains of agutis are met with abundantly in the caverns of Lagoa Santa, in Brazil.

PACAS

The large and handsomely-coloured rodent known in South America by the title of paca (*Cælogenys paca*) is distinguished externally from its allies by the longitudinal rows of light spots ornamenting its fur; while internally it is remarkable for its extraordinary structure of its skull. The hind feet are distinguished from those of the agutis by having five distinct toes, and the limbs are much shorter and the whole build far

more massive than in the latter. In the skull the zygomatic, or cheek, arches are greatly expanded from above downwards, so as to form huge bony capsules on the sides of the face, each of which encloses a large cavity communicating by a narrow aperture with the mouth. Externally the paca is a stout-bodied rodent, measuring

about two feet in length, with rather short limbs, and a broad head, terminating in a blunted muzzle covered with fine hair. The ears are rather small, and scantily clothed with hair; the feet are naked below; and the tail is reduced to a fleshy tubercle. The fur is coarse and closely applied to the body. The colour varies from fawn to blackish, and the number of longitudinal rows of spots is likewise variable, being in

some instances only three, while in others there may be five such rows. The female has two pairs of teats, placed at a considerable distance apart.

The paca has a very extensive range, being found throughout the greater part of South America as far as Paraguay. In Brazil it is fairly common, but is much scarcer in Paraguay, while in Peru it is rare. It occurs in Tobago and Trinidad, but is unknown to the west of the Andes. In the highlands of Ecuador, at elevations of from six thousand to ten thousand feet, it is represented by Taczanowski's paca (*C. taczanowskii*), distinguished by its inferior size, and the difference in the form of the skull, as well as in colouring.

The habits of pacas appear to be very similar to those of the agutis, these rodents going about either singly or in pairs, and being strictly nocturnal. Their resting-place during the day is either some cavity among the roots of a forest tree, or a burrow excavated by their own exertions, and reaching a depth of from four to five feet; and their food is precisely similar to that eaten by agutis. In disposition they are shy and timid, and when pursued they invariably make for the water, in which they swim well and with considerable rapidity.

During the summer the female produces a single—occasionally two—offspring, which is believed by the natives to remain in the burrow during the period of suckling, which is several months in duration. The Ecuador paca, which is said to be not uncommon in the forests on both sides of the Andes, makes a burrow with two entrances, in which a male and female take up their residence. The natives, who hunt these animals for the sake of their flesh, pursue them in the forests with dogs, and then drive them out from their burrows by lighting a fire at one of the entrances.

The skin of the paca is so thin, and its hair so coarse



THE PACA

and harsh, that its coat is of no commercial value. Its flesh, however, is white and well-flavoured, and on this account the animal is much sought after by the natives of the countries it inhabits. During the months of February and March pacas become extraordinarily fat, and it is at this season that their flesh is most esteemed. In the woods of Brazil pacas and agutis, together with certain edentates, are the only mammals whose flesh is eatable, and they are accordingly most acceptable to the traveller, who is often compelled for long periods to subsist on a vegetable diet.

BRANICK'S PACA

Branick's paca (*Dinomys branicki*) is a rodent of considerable interest, as it in some degree forms a connecting link between the pacas and the other families of the

present group, and on these grounds has been made the type of a family by itself, the *Dinomyidae*. In size and general form of the head and body, as well as in colouring, this rodent closely resembles the paca, from which it is distinguished externally by its rather long and thickly-haired tail, by each foot having four toes, and by the vertical cleft on the upper lip. Internally it differs by the complete clavicles, and by the molar teeth being divided into transverse plates of enamel, as in chinchillas and caviés. The first example was discovered one morning at daybreak in 1873 wandering about the courtyard of a building in Peru, and from that date nothing more was heard of it till 1904, when specimens were obtained by Dr. A. E. Goeldi in Amazonia; its true home being apparently the forests of the eastern slopes and table-lands of the Bolivian and Peruvian foot-hills.

THE CAVY TRIBE

THE caviés, familiar to all from childhood in the shape of the domesticated guineapig, form a well-marked family (*Caviidae*) distinguished by the following characters. The limbs are similar to those of the agutis, and furnished with four toes in front and three behind. The collar-bones are imperfect, and the molar teeth divided by continuous folds of enamel into transverse plates. As indicated by the well-known catch concerning the guineapig, the tail is short or rudimentary. The incisor teeth are short, and the lower jaw differs from that of the agutis in having a strongly-marked ridge on each external surface. The majority of the members of the family are terrestrial, but one species is aquatic.

CAVIES

The true caviés, as represented by the guineapig, are comparatively small rodents, characterised by their stout build, short and sub-equal limbs, small ears, and the total absence of a tail. All the wild species are uniformly coloured, and their range comprises the whole of South America.

One of the best known of the many species is the restless cavy (*Cavia porcellus*), of Uruguay and Brazil, which measures rather more than 10 inches in length, and attains a weight of about one pound. The colour of the rather long and coarse fur is greyish brown; and the incisor teeth are white. This species is common in certain districts in the neighbourhood of the Rio de la Plata, where it is known by the name of *aperéa*. It is occasionally found on the sandhills or the hedges of aloes and cactuses, but its more usual and favourite haunts are marshy spots covered with aquatic plants. In the latter situations it lives among the shelter of the vegetation, but in sandy districts it excavates burrows.

This cavy comes forth to feed in the evenings and mornings, but in cloudy weather may sometimes be seen abroad at all hours. In Paraguay it is invariably found in moist situations on the borders of the forest, where it lives in societies comprising from six to fifteen individuals among the dense masses of bromelia. Here it makes regular beaten paths, and never wanders far afield. It breeds but once a year, producing only one or two young. Cutler's cavy (*C. cutleri*), from Peru, is a rather smaller species, distinguished by the

general black hue of the fur, although the flanks and more especially the under parts tend to brown.

Much discussion has arisen as to the origin of the domesticated guineapig, which was long considered to have been derived from the restless cavy, although several writers pointed out that from its dislike to wet and cold such an origin was improbable. From the researches of Dr. Nehring it appears, however, that the real ancestor of the domesticated breed is Cutler's cavy. It has been ascertained that the latter species was domesticated by the Incas in Peru, whence it was carried to Colombia and Ecuador; while, on the other hand, no cavy was ever domesticated in Brazil. The domesticated caviés of the Incas were either uniformly white or reddish brown, or a mixture of those two colours.

In Europe guineapigs are generally white or white marked with yellow and black. Occasionally, however, they may be white marked with pale yellow, and in

some cases they have pink eyes. Sometimes, again, they may be white marked with brownish black, mouse colour, or yellowish grey; while in certain cases the black may be replaced by ashy grey, when the eyes are pink. There is also a breed, commonly known as the Japanese, with long, coarse hair, and of larger size than ordinary.

Guineapigs were introduced into Europe by the Dutch during the sixteenth century, shortly after the discovery of America; the name being probably a corruption of Guiana pig. From their

pretty appearance and ways, as well as the ease with which they are kept and the rapidity with which they multiply, guineapigs have always been favourite pets with children, although it must be confessed that from their stupidity and want of affection they cannot be regarded as very interesting creatures. When, however, a number are kept together they form a pretty sight; and the manner in which they follow one another in unbroken order round and round their place of confinement is remarkable. In some respects they resemble rabbits in their habits, while in others they are more like mice. Their pace is by no means swift, and consists partly of a series of short springs; and the peculiar manner in which the body is elongated in creeping is familiar to all.

Their food consists of roots, corn, and various vegetables; and it is essential to the well-being of these



GUINEAPIGS

rodents that the place where they are kept should be dry and warm. If supplied with abundance of fresh vegetables guineapigs do not require water, and when they do drink they take little, and this with a lapping action. When pleased, guineapigs utter a soft, murmuring cry; when alarmed, this changes to a squeak, while a series of short grunts, from which they probably derive their name, appears to be their mode of expressing their wants and desires. The two sexes live in company, but each male selects a partner from the herd, and during such selection conflicts not infrequently take place between rival males.

Few animals exceed the guineapig in fertility, and this is more remarkable since wild cavies increase but slowly. In Europe the female will produce from two to three litters in a year, each of which may contain from two to five young; while in warmer regions the number produced at a birth may be as many as six or seven. The young are brought forth in a highly-advanced state of development, with their eyes fully opened, and even their milk teeth already shed. In a few hours they are able to run by the side of the mother; while by the second day they are able to nibble not only soft plants, but even corn. They are suckled for a fortnight, during which period they are tended carefully by the dam; but after this the parental affection rapidly wanes, and in three weeks—by which time the parents have again paired—the young are left to shift for themselves. In from five to six months the young guineapig is able to reproduce its kind, although it does not attain full maturity till eight or nine weeks. With care, these rodents will live for six or eight years. Although guineapigs seem too stupid to display the slightest affection for their owners, they have the great advantage of never making any attempt to bite, and may therefore be handled by children with impunity.

Many persons have been puzzled to account for the fact that while the ancestral wild cavies are uniformly greyish-coloured animals, the domesticated guineapig is usually marked with patches of black, or orange, and white. The explanation is not far to seek. As the result of hybridisation, what is known as the dissociation of colours frequently takes place. For instance, hybrid mice may be either black or sandy-coloured. The black breed is due to the elimination, probably by crossing with an albino, of the rufous element in the colouring of the typical grey coat; while, conversely, sandy or fawn-coloured mice are the result of the elimination of the black constituent of the compound colour. The various distinct colours or patches of colour in the guineapig have doubtless originated in a similar manner; that is to say, by the breaking up of the composite colour of the coat of the wild guineapig owing to a cross with an albino sport.

The Bolivian cavy (*C. boliviensis*), which is of rather smaller size than the restless cavy, is interesting from its habitat. It lives among the higher regions of the Bolivian Andes at elevations of from ten to twelve

thousand feet, dwelling in large societies, and forming burrows which completely undermine the whole ground in certain districts. In colour this species has the fur of the upper parts grey, with a yellowish tinge, while the throat and under parts are white, and the feet whitish. The incisor teeth are orange in front.

The last species of the genus noticed here is the rock cavy (*C. rupestris*), differing from those already mentioned by the extreme shortness of its claws, which scarcely project beyond the toes. It has a fur greyish above and whitish beneath, and inhabits rocky districts in certain parts of Brazil, dwelling in cracks and crevices, and not constructing burrows. It is much hunted by the Indians, to whom it is known as the hoki.



THE MARA

MARAS

From the true cavies the larger rodent known as the mara, or Patagonian cavy (*Dolichotis patagonica*), is distinguished by its longer limbs and ears, and the presence of a short tail, which is always turned to one side. Its skull is characterised by the extreme narrowness of the front portion of the

palate; this being carried to such an extent that the premolar teeth of opposite sides are actually in contact at their front edges.

In length it is from 30 to 34 inches, and it stands about 13 inches at the shoulder. The fur is thick and crisp, and of a greyish colour on the upper parts, but on the flanks it becomes rusty yellow, and beneath white. The rump is black, with a broad transverse band of white, extending when fully expanded to just above the tail; and the limbs are rusty yellow, but greyish in front. The hair of the throat is elongated into a fringe.

Both in habits and general appearance the mara has a superficial resemblance to the hare, but the legs are longer, and the ears shorter and wider. It inhabits not only the barren country from which it derives one of its names, but likewise extends northwards into the grassy pampas of Argentina, where it ranges as far as Mendoza, in lat. 33° 30'. On the Atlantic coast, however, where the climate is moister, it only ranges as far north as 37° 30'; while its extreme southern limit is about the 48th parallel. A second and smaller species (*D. salinicola*), from the salt deserts of Southern Argentina, lacks the white patch on the rump.

Absolutely dry and more or less desert-like districts are essential to the well-being of the mara, and it is probable that its original home was the Patagonian wastes. In Patagonia the mara is so common as to form almost a characteristic feature in the landscape, Darwin observing that it is usual "to see in the distance two or three of these cavies hopping one after the other in a straight line over the gravelly plains, thinly clothed by a few thorny bushes and a withered herbage."

These rodents are found either in pairs or in parties of from four to eight individuals, but occasionally in large flocks of thirty or forty. They live in burrows generally excavated by themselves; and differ from the other cavies in being diurnal. To protect its eyes from the

glare of the midday sun, the mara has well-developed eyelashes, which are wanting in its nocturnal allies. In disposition these cavies are extremely shy and timid, taking to flight at the least alarm, and generally trusting to their legs, rather than to the shelter of their burrows, for safety. Their food consists chiefly of grass and the roots and stems of such other plants as grow near their burrows. Of their reproduction, it is only known that the female produces twice in the year from two to five young, which are born and nurtured in the burrow. They have been introduced into several English parks, where they have bred freely.

Maras are among the few mammals that habitually enjoy basking in the full sunshine. When thus reposing they usually lie stretched out on their sides or flat on the belly; and in the latter posture bend the fore foot backwards in a manner unlike any other rodent. When disturbed, they at once assume a sitting position, resting on their fore feet and heels, and raising their heads as high as possible in order to see whence the danger comes. After taking to flight, they stop when they have run fifty or a hundred paces, and turn to look round; repeating this process after having again run a short distance. When caught young, they can be tamed without much difficulty, although they require to be tethered. By the natives maras are hunted for their flesh; but this, although white when cooked, is described as being dry and tasteless.

Fossil remains of three species of these rodents have been obtained from the caves of Lagoa Santa, in Brazil, one of these being probably inseparable from the existing form.

CARPINCHOS

The carpincho or capivara (*Hydrochaeris capivara*), which takes its second name from a Spanish modification of the native term capugua, is the largest of living rodents, reaching a length of about 4 feet, and weighing 98 pounds; on account of this large size, coupled with its bristly hair and grunting cry, it is often designated the water hog. It is a rodent of bulky build, with moderately long legs, small ears, cleft upper lip, no tail, and short webs between the short-nailed toes. The neck is short; the head is long, broad, and much flattened above; the eyes are large and widely separated; and the ears have a notch in the hind border. The hind legs are considerably longer than the front pair. The skin is clothed

somewhat sparsely with long and coarse hair, of a reddish brown colour above, and brownish yellow beneath; the bristles around the mouth being black.

The upper incisor teeth are marked with a broad and shallow groove in front; the molars are characterised by the great complexity of the last tooth of the series, the last molar in the upper jaw comprising some twelve transverse plates, and exceeding the united length of the three teeth in front of it; while

in the lower jaw the corresponding tooth is somewhat less complex, although still much larger than either of the others. This complexity of the last molar, which is quite unparalleled elsewhere among the rodents, presents a condition analogous to that existing in the wart-hogs among ungulates.

The carpincho is distributed over the whole of Eastern South America, as far south as the Rio de la Plata, and also extends westwards into the lowlands of Bolivia and Peru. Fossil remains of the existing species occur in the caverns of Brazil, while in the Tertiary deposits of Argentina, remains indicate one extinct species of 5 feet in length, and a second considerably larger. The living species is thoroughly aquatic in its habits, frequenting the margins of lakes and rivers, and swimming and diving with great speed.

Darwin, for instance, writes that these rodents "occasionally frequent the islands in the mouth of the Plata, where the water is quite salt, but are more abundant on the borders of freshwater lakes and rivers. These animals were very tame; by cautiously walking, I approached within three yards of four old ones. As I approached nearer and nearer, they frequently made their peculiar noise, which is a low, abrupt grunt, not having much actual sound, but rather arising from the sudden expulsion of the air; the only noise I know at all like it is the first hoarse bark of a large dog. Having watched the four, from almost within arm's length for several minutes, they rushed into the water at full gallop, with the greatest impetuosity, and emitted at the same time their bark. After diving a short distance, they came again to the surface, but only just showed the upper parts of their heads."

It frequently associates in large herds, which may comprise twenty or more individuals. Its usual pace is a long trot, of no great swiftness, but when pressed hard, a carpincho will advance in a series of leaps. It has no

regular lair, although the herd generally returns to the same part of the river bank. The general food consists of water plants and the bark of young trees; but in the neighbourhood of cultivated lands carpinchos consume large quantities of water melons, maize, rice, and sugar-cane. In disposition these rodents are quiet and peaceful, not to say stupid, and they never appear to indulge in sportive gambols. They occupy their time either in feeding, or in reposing in a listless manner on the banks of the rivers or lakes they frequent.

When thus reposing, one individual will from time to time raise its head to see if any foe be approaching; and if an alarm arise all soon plunge headlong into the water. In the settled portions of Uruguay they are seldom seen, although their footprints are numerous on the sandy banks of the rivers.

The female produces from five to eight young ones in the year; but it is not yet ascertained whether a regular lair is prepared for their reception.



CARPINCHOS

THE PICAS

THE whole of the rodents hitherto described are characterised by having only a single pair of incisor teeth in the upper, as in the lower, jaw; and they are hence collectively spoken of as the single-toothed rodents, or Rodentia Simplicidentata. On the other hand, the hares and rabbits, together with their cousins the picas, have a second smaller pair of incisors placed behind the large front pair in the upper jaw.

These rodents are accordingly regarded as constituting a group of equal value with the one containing all the other families, for which the term double-toothed rodents, or Rodentia Duplicidentata, is adopted, while they also form the group of Lagomorpha. In the young of this group three pairs of incisors are present in the upper jaw, but the hindmost pair soon disappears, and is not succeeded by permanent teeth. In addition to the extra incisor teeth, these rodents are characterised by the enamel extending all round the larger incisors, instead of being confined to their front surfaces.

In the skull the palate is distinguished by the shortness of its bony portion, in which there are very large vacuities in front, while its hind border is situated between, instead of behind, the cheek teeth. In all cases the latter teeth have tall crowns without roots, and are divided into parallel transverse plates surrounded by enamel. In the hind limbs the bones of the lower leg—tibia and fibula—are united. The upper lip is invariably cleft. Some naturalists consider that the Lagomorpha constitute an order by themselves, with no relationship to typical rodents.

These rodents, which are divided into two families, are all strictly terrestrial in their habits, and have a wide geographical distribution, although more abundant in the Northern than in the Southern Hemisphere.

Most travellers in the Himalaya are familiar with the pretty little rodents known as picas, tailless hares, or mouse hares, which may be seen in the higher regions cautiously poking their noses out from between broken rocks, and again disappearing with the rapidity of lightning directly they catch a glimpse of an intruder. These creatures constitute a family (*Lagomyidæ*, or *Ochotonidæ*) of the present group, of which there is but one living genus *Lagomys*, or *Ochotona*, and present the following characteristics.

All the species are of comparatively small size, being considerably inferior in this respect to a rabbit, and are easily recognised by their small ears, and the absence of any external trace of a tail. The fore and hind limbs are short and of nearly equal length. In the skeleton the collar-bones are complete, and the skull has no descending (post-orbital) process defining the hind border of the socket of the eye. In the living species there are two pairs of premolar teeth, in addition to three molars in each jaw. The picas have the soles of the feet well covered with hair, and the fur of the body is generally thick and soft.

Picas, of which there is a considerable number of species, may be considered as especially characteristic

of Northern and Central Asia, one species alone ranging into Eastern Europe, while others inhabit North America. In Asia the genus extends into Eastern Persia, Afghanistan, the Himalaya, and Tibet. The European pica (*L. pusilla*) extends from the steppes of Russia to Southern Siberia, but in Eastern Siberia is replaced by *L. alpina*, which ranges

into Kamchatka. The latter species may be compared in size to a guineapig, its length being from 9 to 9½ inches. The colour of the long and soft fur is greyish brown on the upper parts, although the individual hairs are of a deep grey near the skin, while beneath it is grey tinged with yellow. The feet are pale, suffused with brownish yellow; and the ears have white margins.

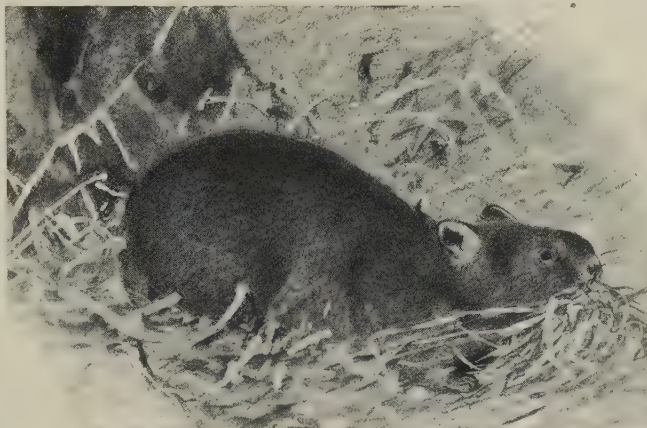
The common Himalayan pica (*L. roylei*), which ranges to elevations of from eleven thousand to fourteen

thousand feet, or more, is a much smaller species, measuring only 6½ inches in length, with fur of a dark brown or bay colour. Other species from the Himalaya, such as the Ladak pica (*L. ladacensis*), however, are larger, the one named measuring 9 inches in length, and inhabiting regions situated at an elevation of from fifteen thousand to nineteen thousand feet above the sea-level.

Picas inhabit only cold and desert regions, and, therefore, in the greater part of their range, are found at high elevations, although in Siberia they can exist at much lower levels. They either form burrows among rocks, or live in the crevices between the rocks themselves, but in the Eastern Himalaya *Lagomys roylei* is found in the pine-forests. Although mainly nocturnal in their habits, picas will often venture abroad in the daytime, especially if the sky be overcast, and they may be seen in the Himalaya darting about in the full glare of the sun. Their food consists of various plants, more especially grasses, and of these a large store is accumulated for winter use.

None of the picas appears to hibernate, although in most of their haunts they must be buried deep beneath the snow for several months in the year. Although often found in the Himalaya in pairs or small parties, picas are more or less gregarious, sometimes associating in very large numbers. In Northern and South-Eastern Mongolia, where they are exceedingly abundant, their burrows consist of a vast number of separate holes, which may be counted by hundreds, or even thousands. From the peculiar loud chirping or whistling cries uttered by many of the species whilst feeding, picas are often termed "piping hares," but this habit does not appear to have been observed in the Himalayan species.

All picas drink little. In summer some amount of rain falls in many of the districts they inhabit, while in winter the snow supplies them with as much liquid as they require, but in spring and autumn there is scarcely even dew in the Mongolian steppes, so that at such seasons they must exist entirely without water. The female gives birth at the beginning of summer to about six naked young, to which she attends with the greatest care.



THE SIBERIAN PICA

HARES AND RABBITS

THE hares and rabbits, of which the more typical species are included in the genus *Lepus*, constitute a family (*Leporidae*) distinguished from the picas by their elongated hind limbs, short recurved tail, long ears, and imperfect collar-bones. The skull is characterised by the extremely narrow frontal region, and the presence of a large wing-like (post-orbital) process defining the hind border of the eye socket; while there are three pairs of premolars in the upper, and two in the lower jaw, the total number of cheek teeth thus being $\frac{5}{5}$ on each side of the jaws. The eyes are large and full, and devoid of eyelids.

In all the species the fore limbs are furnished with five, and the hind pair with four toes each; the soles of the feet being as densely clothed with hair as are the legs. The inner sides of the cheeks are also lined with hair. The females have teats both on the breast and the belly.

With the exception of certain remarkable species from South-Eastern Asia, most of the members of the family are very much alike in appearance and colouring, the usual tint of the fur on the upper parts being a mixture of grey and reddish brown, although in some cases the red, and in others the grey tends to predominate. This type of colouring harmonises well with the general tint of the open country in which most of the species dwell. A noteworthy feature in some species, such as the rabbit, is the pure white of the under surface of the upturned tail; this, in the case of the rabbit at least, serving the purpose of a guiding signal to other individuals in the presence of danger, so that when the leader of a flock is in full retreat towards its hole, the remainder at once see in which direction to follow.

Hares, as most of the members of the family except the rabbit are called, have an almost cosmopolitan distribution, although none is indigenous to Australasia. Out of a very large number of species, the great majority, however, are confined to the Northern Hemisphere, South America having only a few species, among which is the Brazilian hare (*Lepus brasiliensis*).

With the exception of a few species, all the members of the family dwell either in open country among grass and other herbage, or among rocks and bushes. They are solitary, and each inhabits a particular spot known as its "form," this being either a flattened resting-place among grass or bushes, or merely the sheltered side of some rock or stone. As a rule, a hare returns to its form, sometimes day by day, for a considerable portion of the year, but the situation is changed periodically. Hares are mainly nocturnal, going forth at evening in quest of food, and not returning to their forms till after sunrise. Their speed is great, but, owing to the great relative length of their hind limbs, they are better adapted for running uphill than down.

All the members of the genus are remarkable for their extreme timidity, and their long ears are admirably adapted to collect the least sound, and thus give the earliest possible notice of danger. Among European species, the ears are shortest and the legs the least elongated in the rabbit, which dwells in burrows, and has not, therefore, such need of protecting itself by acuteness of hearing and extreme speed. All the members of the family breed with great rapidity, the young being able to reproduce their kind within about six months after birth; but while the young of the hares are born fully clothed with hair and with their eyes open, those of the rabbit come into the world blind and naked. The rabbit has also white, in place of red, flesh.

THE HARE

The common, or brown, hare (page 573), now generally known as *Lepus europæus*, although referred to in older works as *L. timidus*, has a wide range in Western, Central, and Southern Europe, and is characterised by its large size, long ears—which exceed the head in length—the presence of a white streak behind the eye, and of rusty red on the thigh and usually on the flank; the upper surface of the tail is black, like the tips of the ears, but the under side is white. The general colour is rufous tawny, mingled with black above and white below; and there is little difference in colour between the summer and the winter coat, although the latter is invariably the lighter. In the skeleton the ulna is sligher than the radius, and is placed behind it, the humerus is shorter than the forearm, while the latter is about one-fourth shorter than the tibia. Nine local races of this species are recognised, of which the British, typically from Herefordshire, has been named *L. europæus occidentalis*.

With the exception of the north of Russia, Lapland, the Scandinavian peninsula, and Ireland, the brown hare is found over the whole of Europe, ranging as far eastwards as the Caucasus, but in the north of Scotland the species is confined to the low grounds and valleys.

It may be mentioned here that the name *Lepus timidus* was applied by the Swedish naturalist Linnæus to the hares of his own country, and therefore of right belongs to the next species. In the more northern parts of its habitat the hare tends to become paler in winter, while the maximum of rufous in its colouring occurs in the southerly districts.

The hare, like other members of the genus, is an exclusively vegetable feeder, its food consisting of grass, corn, bark, and so forth. In cultivated districts hares often inflict much damage on growing wheat, and likewise on garden vegetables; while the destruction these rodents cause among young trees by nibbling away the bark is sometimes very great. In fine weather hares are usually to be found in the open, but during rain they show a decided



A PARTY OF HARES

HARES

preference for covert, and while on some days they select the bare fallows, on others they repair to fields with long grass or other herbage. On some occasions, either when lying in the open or in their forms, they will almost allow themselves to be trodden upon before stirring; and it is then that they are sometimes captured by the poacher merely walking silently up and throwing himself suddenly upon them. On other occasions they are so wild that it is difficult for the sportsman to come within range, and it has been noticed that they are generally wilder in bad weather, and more so in the afternoon than in the morning.

The hare will take readily to the water, not only to escape from pursuit, but to obtain food or a mate; and there is a record of one actually swimming across an arm of the sea about a mile in width. Professor Thomas Bell observes that "on hearing an unusual sound the first impulse of a hare is to sit upright with erected ears to reconnoitre; then it either endeavours to conceal itself by 'clapping' close to the ground, or at once takes to flight. It is a cunning animal, and the sharp turns or 'wrenches' by which it strives to baffle the fleetest but less agile greyhound, constitute one of the principal beauties of the sport of coursing."

The female produces several litters in the year, the earliest of which may arrive in January and the latest in November. The number of young in a litter varies from two to five; and the leverets, as the young are called, are suckled for about a month, after which they are left to shift for themselves; they are born with their eyes open and the fur fully developed. The statement that hares sleep with their eyes open is incorrect.

THE BLUE, OR MOUNTAIN, HARE

The blue, or mountain, hare, also known as the Alpine hare (*Lepus timidus*), is a smaller animal than the brown species, with shorter ears, hind legs, and tail, the head smaller and more rounded, and the colour frequently bluish or brownish grey above in summer, without rufous or brown on the flanks, but with black tips to the ears, and white beneath; the upper surface of the tail being either white or dark. As a rule, the fur, with the exception of the black ear tips, turns white in winter (page 115).

The typical representative of this species inhabits Southern and Central Sweden, but the North Swedish and Russian race is regarded as distinct, as are the two Irish races. The first of the latter (*L. timidus hibernicus*); in common with the typical race, has ears shorter than the head, and the tail white above and below at all seasons, and usually has a little rufous on the front surface of the upper part of the hind legs, the general colour of the summer coat being reddish brown, often with a tinge of foxy. In severe winters it may turn white. Around Dublin is found a second race (*L. t. lutescens*) characterised by the rich, dark leathery colour of the upper parts, passing gradually into the white of the belly, and the absence of black tips to the ears.



BLUE HARES

In the Scottish mountain hare (*L. t. scoticus*) the ears are somewhat longer, being about equal in length to the head, while the greater portion of the upper surface of the tail is dusky in summer, and the upper part of the hind legs and flanks white, without any trace of rufous on the former. This race turns wholly white in winter, except for the black ear tips. On account of these differences the Scottish hare has been referred to as a distinct species, *Lepus medius*, typically from Zealand, although, together with the allied races, it may be included in *L. timidus*. These races comprise

L. t. medius of Zealand, *L. t. caspicus* of the Caspian provinces, *L. t. varronis* of Graubunden and Upper Bavaria, *L. t. brevicaudatus* of the Swiss Alps, *L. t. altaicus* of the Altai, and *L. t. ainu* of Japan.

In Arctic America the white hare is represented by the species or race known as the Polar hare (*L. arcticus*), which appears to be white at all seasons.

In general habits the mountain hare agrees very closely with the brown species. Its "form" is made in the clefts of rocks, or between stones; and during the winter its food consists largely of lichens and pine seeds.

In summer it ascends the higher mountains. It produces from four to six young at a birth, and it is doubtful if there is more than one litter in a year. It is more inclined to seek shelter under tree stems, thick evergreens, and the like than is the brown hare, and the young are believed to be produced in sheltered covert. In Arctic America the Polar hare remains active throughout the winter, feeding chiefly on the berries of the arbutus and the bark of dwarf willows.

AMERICAN HARES

In addition to the Polar hare, North America is the home of several species of the genus, some of which turn white in winter, although the bases of the hairs retain their normal colour. Among these are the prairie hare, or "jack rabbit" (*L. campestris*), distinguished by its large size, long ears, and the white hue of both surfaces of the tail, and the smaller varying hare (*L. americanus*), with shorter ears, and the tail dark above.

Of the North American species which do not turn white in winter, the best-known is the small wood hare (*L. floridanus*), also termed grey rabbit, or "cotton tail," in which the usual colour of the upper parts is grey, varied with black, and more or less tinged with yellowish brown, while the under parts are white.

This hare is a southern species, not ranging farther north than the Adirondack region. In habits this species approximates somewhat to the rabbit, frequently dwelling in hollow tree stems or the deserted burrows of other mammals. It is a prolific species, producing young three or four times a year, and usually from four to six at a birth. In open ground the female scratches a shallow hollow, in which to bring forth her young, forming in this a nest of soft leaves and grasses, well lined with fur from her own body. When the parent is absent, the young are always completely covered and concealed in the nest, which they leave

at an early age, and separate from the mother so soon as they are able to take care of themselves.

Along with certain allied American species, the wood hare constitutes the subgenus *Sylvilagus*, and in this may be included the tapiti, or Brazilian hare (*L. brasiliensis*), although it is sometimes made the type of an exclusively Central and South American group of species under the name of *Tapiti*.

Considerably smaller than a rabbit, the tapiti has more the proportions and colour of the brown hare, although the ears and hind legs are relatively shorter, and there is more black mingled with the brown of the hair. The most characteristic feature of the species is the rudimentary condition of the tail, which is reduced to a mere knob, coloured both above and below very much like the back. A tail of such diminutive proportions would be of no use as a guiding signal for the members of the drove, and it is consequently not white on the under surface, as in most members of the family, inclusive of the North American "cotton tails."

The shortness of the tail connects the tapiti with Nelson's hare (*L. nelsoni*), from Mount Popocatepetl, Mexico, a small species, in which the tail is absent, and the legs are so short that the hopping gait of the ordinary members of the family is lost. This species forms the subgenus *Romerolagus*.

More or less nearly allied are the marsh hare (*L. palustris*) of the coast of North Carolina, and the swamp hare (*L. aquaticus*) of the Mississippi swamps, both of which have nearly naked soles to the feet and inhabit swampy ground; they constitute the subgenus *Limnolagus*.

ASIATIC AND AFRICAN HARES

There is a large number of species of hares belonging to the typical section of the genus which inhabits Central Asia, India, and the regions to the east. Of these the Indian black-naped hare (*L. nigricollis*) is distinguished by the presence of a large black patch on the back of the neck, which is wanting in the common Indian hare (*L. ruficaudatus*). Both these species appear to be much less prolific than European hares, and when pursued generally take refuge in holes.

The Afghan hare (*L. tibetanus*), ranging from Baluchistan to Nubra, and found as low as 500 feet above the sea, is distinguished by the black upper surface of the tail and black ear-tips; but in the larger woolly hare (*L. oiostolus*) and the upland hare (*L. hypsibius*) both surfaces of the tail are nearly or quite white. The latter species does not occur below fourteen thousand feet, and I have found it in swarms among eleagnus bush in the higher valleys of Ladak.

In Africa hares referable to the typical section of the genus are found from Egypt to the Cape, those from South Africa, at any rate, affording but poor sport, as their speed is not great, and when pursued they almost invariably run to ground; while some of them, at least, are very foul feeders. The Egyptian

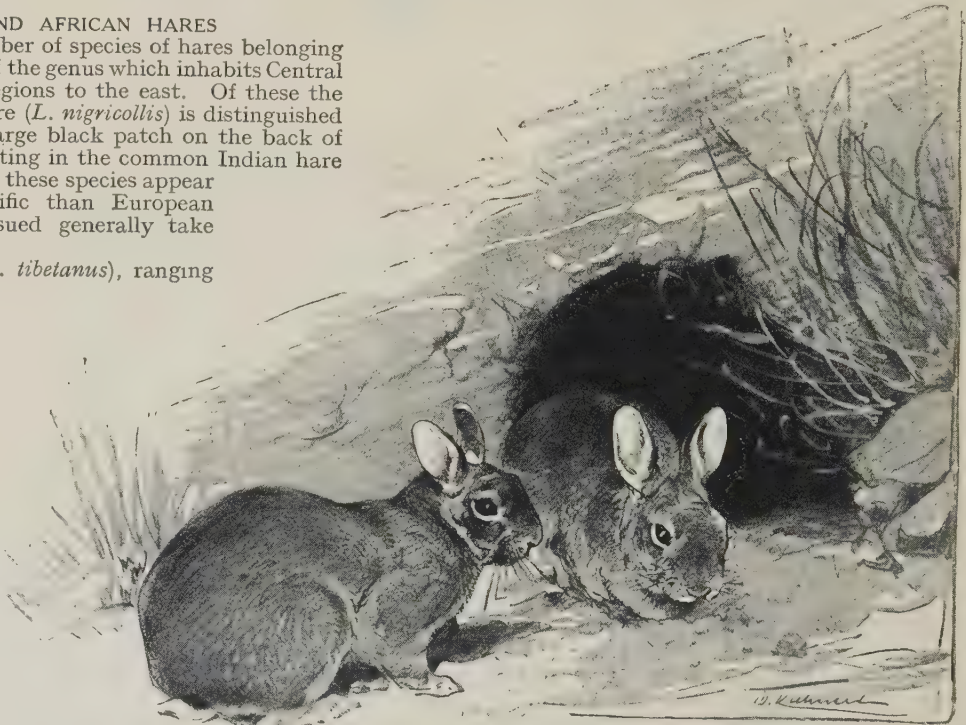
hare (*L. ægyptius*) is considerably smaller than the brown European species, but has relatively longer ears, and paler fur. Of the southern species, the rock hare (*L. saxatilis*) is nearly equal in size to the brown European hare, and has relatively long limbs and ears, with the fur rufous above and dirty white below. The Cape hare (*L. capensis*) differs in its shorter legs, the absence of a rufous tinge on the back of the neck, and the yellowish colour of the throat. When hunted, it always carries the ears erect.

THE RABBIT

The rabbit (*Lepus cuniculus*), representing the subgenus, or genus, *Oryctolagus*, is smaller than the typical hares, with shorter ears, hind legs, and feet, little or no black on the ears, and a generally greyer colour. In the skeleton the ulna is stouter than the radius, the humerus is nearly as long as the forearm, and the latter about one-half the length of the tibia.

The colour is greyish brown, with the neck reddish fawn; the under parts and lower surface of the tail are white; and, at most, only the margins of the tips of the ears white. Black, fawn, or parti-coloured individuals, however, are at times met with even in the wild state, although these are probably due to crossing with domesticated breeds. The length of the wild rabbit is usually about 16½ inches, and its weight from 2½ to 3 pounds, although it may occasionally reach as much as 5 pounds.

These well-known rodents, which, as compared with the hare, are deficient in speed, are eminently gregarious, forming in suitable soils numerous burrows, collectively



RABBITS

termed "warrens." Sandy soils, especially those clothed with heath or gorse, are their favourite resorts; but in damp situations rabbits sometimes content themselves with forming a series of runs among the thickly-matted gorse or heather. Occasionally, it is stated, they will take possession of a hollow tree, and ascend

RABBITS

the stem for a considerable height. Although mainly nocturnal, rabbits, when undisturbed, may be seen abroad at all hours, but their favourite feeding times are in the evening and early morning.

The prolific nature of the rabbit is proverbial, several litters being produced in the course of the year, both during the summer and the winter, the number of young in each litter varying from five to eight. The young are born in a blind and nearly naked condition, and at the age of six months are themselves able to breed. The ordinary burrow usually has two entrances, but the young are born in a special excavation to which there is only a single approach. In this breeding burrow the mother forms a soft nest from her own fur, and during her absence in the day she covers over the entrance with earth. I have seen a rabbit, startled by a dog from a tuft of grass on the margin of a river, plunge into water and reach the opposite bank in safety.

Rabbits, from their numbers, do even more damage to young plantations than is inflicted by hares. The chief foes of these rodents are weasels, stoats, and polecats, which either hunt them in the open, or attack them within the recesses of their subterranean haunts. A curious kind of paralysis seizes the rabbit when pursued by one of these carnivores.

Although now widely distributed, it is commonly believed that the rabbit was originally a native of the countries on both sides of the western portion of the Mediterranean, where it is still abundant at the present day, and whence it is considered to have spread northwards, and to have reached England and Ireland by human agency. The matter, however, is one of great doubt, in regard to which no definite and trustworthy statement can be made. In Scotland rabbits have increased and spread enormously of late years, having been formerly sparsely distributed, and unknown in the more northern parts of the country. On the Continent their distribution is somewhat local, and they are unknown in the more northerly and easterly parts of Europe.

It should be observed that remains of rabbits occur in the caves of England in company with those of the mammoth and other extinct mammals, which would seem at first sight to disprove the view that these rodents are immigrants from the south; but it is possible that the association of the remains of the rabbit with those of extinct mammals may be due to its burrowing habits.

The rabbit has been introduced by human agency into several countries outside of Europe, where it has multiplied to a degree beyond conception—so much so, indeed, that in Australia and New Zealand these rodents have become a perfect pest and a serious hindrance to agriculture.

Rabbits were first introduced at the period of the highest prosperity of Australia and New Zealand by a patriotic man who thought it would be a good thing to import a few, as they would serve for food and sport. He accordingly imported three couples, which were turned loose. It was not long before the district was transformed into a gigantic rabbit warren. Indeed, it was discovered that a single pair of rabbits, in

favourable circumstances, would in three years have a progeny numbering 13,718,000. The inhabitants soon found that the rabbits were a plague, for they devoured the grass, which was needed for the sheep, the bark of trees, and every kind of fruit and vegetables, until the prospects of the state became very serious, and ruin seemed inevitable.



LOP-EARED RABBIT

From New South Wales upwards of 15,000,000 rabbit skins have been exported in a single year, while for thirteen years in succession no fewer than 39,000,000 were accounted for in Victoria. To prevent the increase of these rodents, the introduction of weasels, stoats, mungoes, and the like has been tried; but these carnivores neglected the rabbits and took to feeding on poultry, and thus became as great a nuisance as the animals they were intended to destroy. The attempt to kill them off by the introduction of an epidemic disease also failed.

In order to protect such portions of the country as are still free from the plague, fences of wire-netting have been put up; one of these fences erected by the Government of Victoria extending for a distance of upwards of 150 geographical miles. In New Zealand, where the rabbit was introduced about 1870, its increase has been so enormous, and the destruction it inflicts so great, that it has actually been a question whether the colonists should not vacate certain districts rather than attempt to fight against the nuisance.

Rabbits are stated to have been introduced, possibly from Spain, into the island of Porto Santo, near Madeira, in 1418 or 1419, and their descendants have now formed a race distinguished by their small size, the reddish colour of the fur of the upper parts, and the grey tint of that below. So different, indeed, are these rabbits from the British wild rabbit that it is stated the two will not breed together. These Porto Santo rabbits, which are probably much more nearly allied to Spanish than to English rabbits, have been made the type of a separate race, *L. c. huxleyi*. Tame rabbits which have run wild in Jamaica and the Falkland Islands have not reverted to the ordinary wild form, but still exhibit traces of their domesticated origin. Introduced rabbits are also numerous in

Teneriffe and the Crozet Islands. In Teneriffe, where the breed is small, they do not burrow, but live in crannies among the rocks.

The rabbit has long been kept in a domesticated state, in which it varies not only in colour, but likewise in size, in the length of the fur, in the form and direction of the ears, and also to some extent in the conformation of the skull. The usual colours are brown, fawn, reddish brown, or black, more or less mingled with white; but there are also albino breeds with pink eyes.

Among the most remarkable changes produced by domestication is the assumption of a pendent position by one or both ears, which become greatly enlarged, accompanied by a structural modification in the hind part of the skull. In the ordinary wild rabbit the length of the ears from tip to tip when extended is rather less than 8 inches, and the breadth of each not more than 2 inches; but a "lop-ear" has been exhibited in which these dimensions were respectively 23 and 5½ inches. The weight of these rabbits is, moreover, frequently from 8 to 10 pounds, and has been known to reach 18 pounds. When only one ear hangs down, the rabbit is called a "half-lop," and in some cases this pendent ear is larger than the upright one. Many lop-eared rabbits have also large dewlaps, or folds of skin beneath the throat. Neither whole nor half-lops breed at all truly, and in all lop-eared rabbits the skull is proportionately longer than in the wild race.

The beautiful Angora breed is distinguished by the length and fineness of its pure white fur, which is even of considerable length on the soles of the feet. These rabbits are stated to be more sociable in disposition than other domesticated breeds, and the males do not exhibit that tendency to destroy their offspring which is so characteristic of the rest.

Among other well-known strains, the large hare-coloured, or Belgian, rabbit, commonly known as the "Belgian hare,"

differs mainly from other large breeds in its size and colour; while other strains which breed true to colour are the so-called silver-greys and chinchillas, which are born black, and assume their characteristic colours later. Silver-greys generally have black heads, and legs, and the fine grey fur of the body is intermingled with a number of long black and white hairs. These rabbits have long been kept in warrens, and when crossed with the wild breed, one-half of the progeny, or thereabouts, takes after the one parent, and the second half after the other. On the other hand, chinchillas, or tame silver-greys, have short, paler, mouse-coloured, or slaty fur, among which are long, black, slate-coloured, and white hairs.

Silver-greys may be regarded as black rabbits which become grey at an early period of life. By crossing silver-greys with chinchillas, a certain number of the resulting offspring belong to what is known as the Himalayan breed. When newly born, these rabbits are true albinos, having pure white fur and pink eyes; but in the course of a few months they gradually become blackish brown on the ears, nose, feet, and the upper surface of the tail. In spite of their sudden production, Himalayan rabbits generally breed true, and Darwin suggested that their remarkable change in colour may be due to both chinchillas and silver-greys having descended from a cross between black and albino parents. Lastly, there is the black and white Nicard, or Dutch, rabbit, distinguished by its very small size, some examples not weighing more than a pound and a quarter.

THE RED-TAILED RABBIT

In Southern and Eastern Africa are found several local races of a reddish-coloured rabbit (*Lepus crassicaudatus*) with a remarkably thickly-haired tail of a deeper rufous tint, both above and below, than the body. It is a short-legged species, inhabiting the highlands from Cape Colony to Nyasaland, and living in the crannies of rocks instead of burrows.

SHORT-EARED RABBITS

Different habits characterise the Assam rabbit, or so-called hispid hare (*Caprolagus hispidus*), of the foothills of the Eastern Himalaya, in which the ears are shorter than the skull, while the eyes are small, the fur is coarse and bristly, the tail is dark-coloured all round, and the hind legs are scarcely longer than the front pair. Although not gregarious, this little known species is stated to burrow, and, therefore, probably

produces blind and naked young.

In the Liu-kiu Islands, north of Formosa, the place of the Assam rabbit is taken by the allied *C. furnessi*, a blackish, short-eared rodent, looking more like a hyrax than a rabbit, and referred by some naturalists to a genus by itself.

An allied species is the Sumatran rabbit (*Nesolagus netscheri*), which is certainly distinct enough from the other two species to represent a separate genus.

In a fossil state, the hare

family dates from the Miocene period in North America, where it is represented by several species of the extinct genus *Palæolagus*. A fossil hare from the Pliocene of New Mexico has been referred to another genus, under the name of *Panolax sancta-fidei*



WILD RABBITS IN THEIR HAUNTS

ORDER VI. UNGULATA

GENERAL SKETCH OF THE HOOFED MAMMALS

By R. LYDEKKER

WITH the exception of bats, in which the outermost fingers of the wings are clawless, and some of the seals and their allies, all the mammals with which we have thus far been concerned are characterised by having the digits of both the fore and hind limbs provided with either claws or thin nails. In the greater number of instances, moreover, the fore limbs themselves are endowed to a larger or smaller degree with the power of free movement in several directions; these movements being displayed to the fullest degree among the Primates, where the hand can be rotated upon the forearm, although they are also well-developed in the members of the cat family. Then, again, the number of digits in the great majority of these mammals is five on either one or both pairs of limbs, and in no instance is it less than four. Lastly, with the exception of the rodents, the crowns of the cheek teeth are never complicated by vertical and lateral infoldings of the enamel, so as to produce when worn down an elaborate pattern.

The ungulate or hoofed mammals, such as cattle, deer, camels, swine, horses, tapirs, rhinoceroses, and elephants, forming the next group of mammals to occupy our attention, differ in many important respects from members of the preceding orders. No existing member of the order, for instance, has the feet provided with claws, and in the great majority of cases the toes are enclosed in solid hoofs, although in a few they are furnished with broad and flat nails; while the movements of the fore limbs are mainly or entirely restricted to a backwards-and-forwards motion, and in no case can the fore foot be rotated on the fore leg.

Many extinct forms have five or four functional and well-developed digits to the limbs, but in all living members, except the elephants, there are never more than four functional digits; and in a large number of instances these functional digits are two, or more rarely three, in number. Some species, like the giraffe, have, indeed, only two toes to each foot, while in the horse and its living allies, together with a remarkable extinct species from South America, only a single toe remains.

It must not, however, be assumed that the toes are gradually reduced from three to two, and from two to one; the fact really being that the reduction takes place along two entirely different lines, in one of which the number is diminished from four to two, and in the other from three to one. It is of primary importance, in order to understand the relationship of existing ungulates to one another, to have a clear idea of the manner in which this reduction of the toes takes place.

In all the ungulates the limbs have ceased to be used as organs of prehension, and there seems to be no necessity why there should be any adherence to the primitive five-toed type as development advances. The majority of the members of the order, however, being unable to protect themselves against foes, and being also, in proportion to their height, heavy-bodied animals, the attainment of a high degree of speed was essential to their well being and development, if not their actual existence. For such a kind of life the

greater the length and slenderness of limb, the greater will at first sight be the speed. Now, to produce a long and slender, and at the same time a strong, limb from a stout and short-toed one, greater strength will be attained by reducing the number of the toes, and lengthening and strengthening those which remain, rather than by lengthening the whole of the five toes, the slender bones of which would be liable to fracture by the concussion of the solid hoofs against the ground.

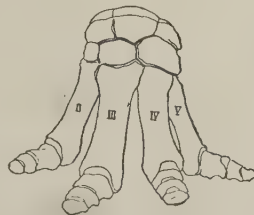
Accordingly, among the ungulates the plan has been gradually to lengthen and strengthen the bones of one or more of the original five toes and dispense more or less completely with the others. In almost the lowest Tertiary rocks of Europe and North America there occur, for instance, the remains of certain large ungulates, known as coryphodons, in which both the fore and hind feet have five complete toes. The metacarpal bones and the toe bones by which they are succeeded are very short; and these animals walked to a certain extent upon the soles of their feet in the old-fashioned plantigrade manner, although the coryphodons themselves were partially digitigrade in the fore feet, but entirely plantigrade in the hind limbs. The third or middle toe is larger than any of the others, and symmetrical in itself. Another feature of this type of fore foot is that the component bones forming the two horizontal rows of the wrist are placed almost vertically one above another.

In the overlying Miocene Tertiary deposits there are found other large ungulates with a foot in which all trace of the first toe has disappeared, while the metacarpal bones of all the others have become very much more elongated, in consequence of which the animal no longer walked upon the soles of its feet, but entirely upon the toes, or was, in other words, digitigrade. The third toe has become still larger in proportion to the others; while the upper row of wrist bones appears to have been slid over those of the lower row towards the fifth toe. It will be obvious that this interlocking of the bones of the wrist produces a joint much more capable of resisting strain than is that of the coryphodon. The hind foot of the titanothere, however, exhibits a still further advance, having lost the fifth as well as the first toe, and thus being three-toed. The living tapirs are in a precisely similar condition, being four-toed in front and three-toed behind; but the rhinoceroses have advanced one step still farther, having only three toes both in front and behind.

In the foot of the titanothere, while the bones of the metacarpus have become longer than in the coryphodon, the toe bones still remain as short as in the latter; and the same is the case with the rhinoceroses. All these are, indeed, bulky animals, fitted for dwelling in swampy localities, and not specially adapted for speed. In another group, however, the toe bones themselves have become elongated, while the metacarpal bones are still longer and more slender. In two other types of feet the middle or third toe is very much larger than any of the others; but whereas in the one the fifth toe still remains, in the other it is represented only by a



LEFT WRIST
AND FORE FOOT
BONES OF
CORYPHODON



LEFT WRIST AND FORE
FOOT BONES OF TITANO-
THERE

The bones of the metacarpus are indicated by numerals

rudiment of the upper end of its metacarpal bone. This type leads on to that of the extinct three-toed horse, or hipparion, of the Pliocene Tertiary, in which the two side toes have become still smaller, and the last trace of the fifth has disappeared. Finally, at the very top of the geological series, comes the horse, in which the only remaining toe is the third, now very large; the metacarpal bones of the second and fourth toes being represented solely by the small splints on each side of the single large metacarpal, now known as the cannon bone (page 65).

A complete transition has thus been traced from a five-toed ungulate, walking partly on the soles of its feet, to one provided with only a single toe to each foot, and walking entirely upon the very tip of that one toe, by which means the full extent of the limb comes into play as an aid to speed. Throughout this series it is the third or middle toe which has undergone development at the expense of the others; and since this toe is always symmetrical in itself, the term odd-toed ungulates (*Perissodactyla*) is applied to the members of the group thus characterised. So far as can be seen, the horse and its relatives have, indeed, attained the supreme development of which the odd-toed ungulate type is capable, so that further specialisation seems impossible, unless it be the complete discarding of the useless splint bones.

The resources of nature, however, are manifold, and instead of this being the only line of evolution of the ungulates, nearly similar results have been reached by a totally different series of modifications. Starting once more from a foot somewhat similar to that of the coryphodon, it will be found that instead of the third toe remaining symmetrical in itself and gradually increasing in size at the expense of the others, the third and fourth toes become symmetrical to one another on each side of a vertical line drawn between them.

When this takes place, the first toe disappears, and the second and fifth toes become diminished in size; an instance of this stage of development being presented by the pig, where the two large and medially-symmetrical toes represent the third and fourth of the typical series, while the two small lateral ones are the second and fifth. In the pigs all the metacarpal bones remain distinct and relatively short; but in the water chevrotain of Africa the third and fourth metacarpals become much elongated and closely applied to one another, while the second and fifth metacarpals are reduced to mere splints, and their toes are so diminished as to become practically functionless.

Finally, in the deer, oxen, and their allies the third and fourth metacarpals in the fore limb, like the corresponding metatarsal bones in the hind limb, have become completely fused into a single rod-like bone, corresponding in function with the cannon bone of the

horse, and generally known by the same name. The dual origin of the cannon bone, however, is proclaimed by the formation of its lower extremity, which carries two pulley-like surfaces, with which the bones of the two functional toes—the third and fourth—articulate, instead of the single pulley characteristic of the horse's cannon bone.

Since all the ungulates displaying this second modification of foot structure agree in having the third and fourth toes arranged symmetrically to a line drawn between them, they are collectively termed the even-toed ungulates, or *Artiodactyla*.

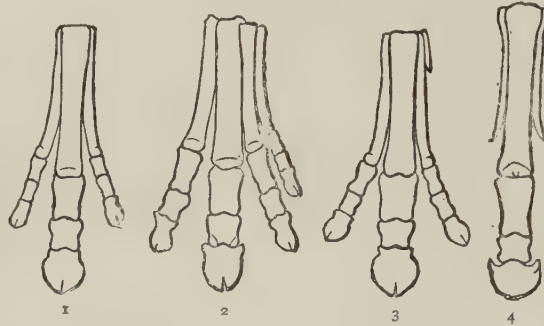
It is accordingly evident that although a few modern ungulates, like the elephant and the hyrax, retain a generalised type of foot, the greater number of the modern representatives of the order

are characterised by their more or less markedly specialised feet.

As regards their teeth, ungulates are characterised by those of the cheek series having broad crowns, surmounted either by columns or transverse ridges, and adapted for grinding and masticating vegetable substances. In the more specialised forms, like cattle and horses, these cheek teeth have their columns or ridges of great height and closely approximated to one another, in consequence of which the bases of the hollows or valleys by which these columns or ridges are separated from one another cannot be seen when the tooth is unworn; while the pattern produced on the crown by the wearing down of these columns or ridges is very complicated, owing to the alteration of substances differing in hardness and colour. On the other hand, in the more primitive types, such as pigs and tapirs, the crowns of the cheek teeth have low columns, or ridges, so that the bases of the intervening valleys can be distinctly seen at all stages of wear.

Speaking generally, it will be found that while all the earlier ungulates have short-crowned cheek teeth, the greater number of the more specialised living species have high-crowned ones; and it will also be observed later that the development of high-crowned teeth has taken place independently in each of the four great groups into which existing ungulates are divided. This is exemplified by the fact that the molar tooth of a horse, although presenting a considerable general resemblance to that of an ox, is yet markedly different, and in reality formed on the same plan as the simple molar of its relative the rhinoceros. It should also be mentioned that whereas in carnivores the upper molar teeth generally approximate more or less to the primitive triangular type, in all existing ungulates they have assumed the quadrangular form.

The food of ungulates, consisting in most cases entirely of vegetable substances requiring much mastication, is the inducing cause of the complex structure of the cheek teeth in the more specialised kinds; and to the



LEFT FORE-FEET OF (1) THREE-TOED AND (2) FOUR-TOED HORSE-LIKE ANIMALS; (3) HIPPARION; (4) HORSE



A BONES OF (A) FORE AND (B) HIND FEET OF AN EXTINCT DEER

THE HOOFED MAMMALS

same cause may be attributed the fact that ordinary ungulates always retain the full number of molar teeth, and, except in the camels, at least three out of the typical four premolars. In this respect they are in marked contrast to the carnivores, in which, as we have seen, there is a great tendency to a reduction in the number of the molar teeth, only one living member of the order, the big-eared fox, having the typical three molar teeth in the upper jaw.

On the other hand, among the more specialised representatives of the ungulate order, there is a decided tendency to the reduction, either in size or number, of the front teeth; the tusks being very frequently small or absent, while the whole of the incisor teeth and sometimes the canines also in the upper jaw, and more rarely both incisors and canines in the upper and lower jaws, may be wanting.

Most of the earlier ungulates, and also the modern pigs, however, have well-developed tusks, as well as the full number of front teeth; and it is thus apparent that in this respect also the result of specialisation has been the reverse of that in the Carnivora, where the tusks have attained extreme development, and the full typical number of incisor teeth is very generally retained. In both cases these distinctions are due to the difference in the nature of the food and habits of the two groups of animals. In addition to these characters of their feet and teeth, the ungulates of the present day are characterised by the total absence of collar-bones, or clavicles, in the adult condition, although traces of these may occur in the foetal state.

Having said thus much in regard to the structure of their limbs and teeth, it will be well to endeavour briefly to summarise the chief characteristics by which the existing members of the ungulate order may be distinguished collectively from other groups of mammals.

To begin with, all ungulates are adapted to a life on land, while, with the exception of certain species of hyrax, none is arboreal. Then, whereas some of the more generalised forms are omnivorous, all the more specialised kinds are strictly vegetable-feeders. In all cases the cheek teeth have broad crowns, furnished with columns or ridges of greater or less complexity; and there are never fewer

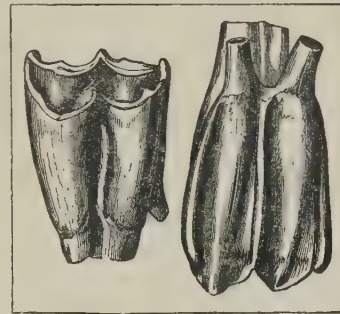
than three pairs of molar teeth in each jaw. Collar-bones are invariably absent; and the limbs are, as a rule, restricted entirely to a backwards-and-forwards motion, there being no power of rotating the fore foot on the fore leg. The upper end of the radius or smaller bone of the fore limb, instead of being rounded, is accordingly elongated transversely in the typical ungulates.

The terminal joints of the toes are generally invested in solid horny hoofs, although in some cases furnished with broad and blunt nails, but never with claws; and the number of toes is very rarely five, and may be

reduced to three, two, or even one; while in a large number of instances where four toes are present, only a single pair of these is of functional importance.

When, however, fossil species are taken into consideration many of these characteristic features will not hold good; certain extinct mammals, which it is

very difficult to separate satisfactorily from the ungulates, have either collar-bones or claws, or perhaps both. In others, again, the upper molar teeth, instead of having square crowns, show the triangular shape occurring in many Carnivora. Indeed, strange though it may seem, the connection between the early Carnivora and the early Ungulata is so close that it is frequently a matter of



A B
LEFT UPPER MOLAR TOOTH OF
THE NILGAI

(A) Inner side (B) Outer side

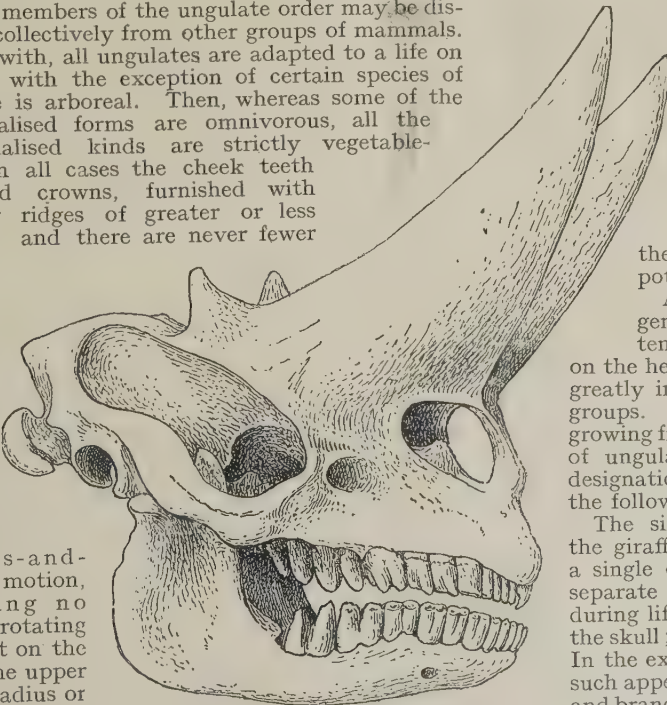
some difficulty to determine to which group an extinct form should be referred; and it is highly probable that Ungulata are really a side branch, descended from the same stock which gave rise to Carnivora. This difficulty, or rather impossibility, of defining groups of animals, when we have to take into consideration their extinct relatives, is merely what must of necessity be the case if the doctrine of evolution be the true explanation of their mutual relationship.

As a rule, existing ungulates are characterised by their relatively large size; and among the order are included the most bulky of all land mammals. There is, however, great variation in point of size among the order; the smallest forms being the pigmy hog, the royal antelope, the chevrotains, and the hyrax; while the largest are the elephants, the hippopotamus, the rhinoceroses, and the giraffe.

A frequent, although by no means general, peculiarity of ungulates is the tendency to the development of horns on the head, the nature of these growths varying greatly in form and structure in the different groups. If all the prominences or appendages growing from the foreheads of the various species of ungulates be included under the common designation of horns, these may be divided into the following five structural types.

The simplest type is the one presented by the giraffe, in which three bony prominences—a single one in front and a pair behind—quite separate from the underlying bones and covered during life with skin, occupy the front surface of the skull; bristly hairs surmounting the hind pair. In the extinct *Sivatherium* there are two pairs of such appendages, of which the hind pair are large and branching, and were probably covered during life with either skin or very thin horn. At

all events, they were not shed like the antlers of deer. The male okapi has a pair of skin-covered horns of the same general type as those of the giraffe—which are common to both sexes—but crowned with small caps of bone, corresponding to the antlers of deer. Taking next the small Asiatic deer known as muntjacs,



SKULL OF ARSINOITHERIUM

or barking deer, we find a pair of skin-covered horns, or "pedicles," evidently corresponding to the paired horns of the giraffe, although welded to the bones from which they grow. From the summits of these pedicles arise secondary outgrowths, at first covered with skin or "velvet," which—owing to the growth of a ring of bone at the base arresting the flow of blood—eventually dry up and leave bare bone incapable of further growth.

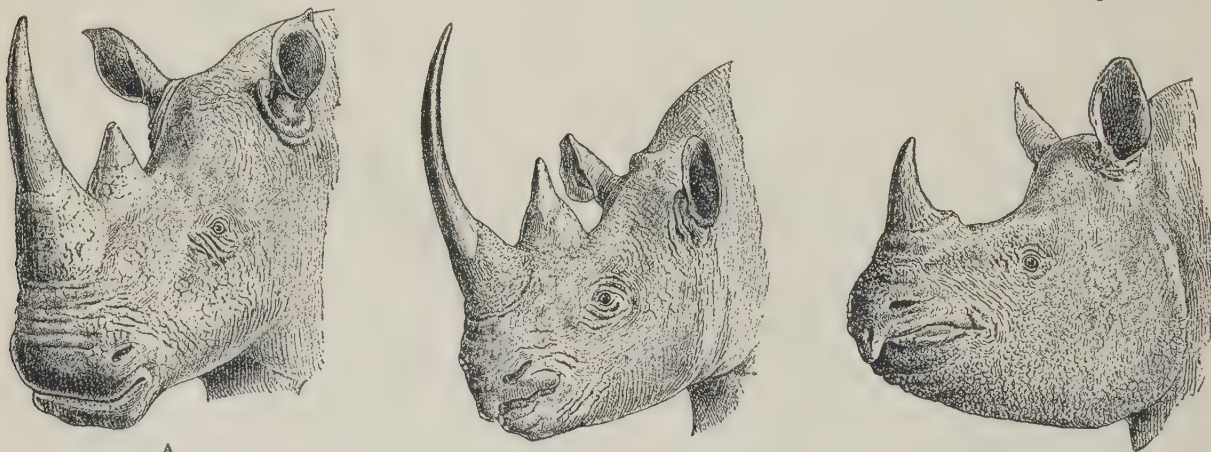
In the muntjac the bare bony part, or "antler," is small in proportion to the skin-covered pedicle, and simple in structure; but in the majority of deer the antler increases in size at the expense of the pedicle, which dwindles till the culminating development is reached in such species as the sambar and the wapiti. Owing to liability to decay or necrosis, the permanent retention of such a mass of dead bone would be a menace to the life of the animal; and the antlers are consequently shed annually, or, at least, every few years, to be renewed the following year, until the animal is past its prime. Generally these new antlers become larger than their predecessors; and the periodical shedding is necessary in order that this gradual increase in size may take place. With the exception of the reindeer, antlers are the prerogative of the male sex alone.

offspring of another, if, indeed, each has not been evolved altogether independently of the rest.

Be this as it may, the horns of the rhinoceroses evidently indicate a fundamentally distinct and independent line of development, since these animals belong to the odd-toed section. In modern rhinoceroses the one or two unpaired horns consist throughout of "horny" matter; that is, of closely welded hair-like fibres, with merely a slight hollow at the base, which fits upon a corresponding boss on the skull. At first sight it seems natural to suppose that this structure may have been derived from a horn of the ruminant type by the gradually dwindling of the bony core and the solidification of the sheath; but this is negated by the fact that the earliest extinct members of the group were hornless.

The rhinoceros horn must therefore be regarded as a structure by itself, which has probably started as a horny nodule and gradually developed to the size characteristic of the white species.

That extraordinary monster *Arsinoitherium* (page 615), from the Lower Tertiary beds of Egypt, is of special interest as showing that horns of the fourth type are not restricted to ruminants, since in this animal the enormous pair of bony cores in the fore part of the



HEADS OF (A) WHITE RHINOCEROS, (B) BLACK RHINOCEROS, AND (C) GREAT INDIAN RHINOCEROS

A third type of horn is presented by the American prongbuck, or pronghorn, in which bony processes or "cores," corresponding to the horns of the giraffe, but welded to the skull, have acquired a horny sheath in place of skin, the sheath being in this instance forked and annually shed and renewed, although the core is simple. In this ruminant the sheath is permeated by, and largely composed of, bristly hairs, thus suggesting a connection with the bristly hairs surmounting the giraffe's horns. Female pronghorns may or may not carry horns.

In the majority of the so-called hollow-horned ruminants, such as cattle, sheep, goats, and antelopes, the horny sheath, or true horn, forms a simple unbranched cone, which may be compressed, or spirally twisted, or curved in one or more directions, but is permanently retained and continues to grow throughout life from the base, while it becomes worn away at the tip. In most cases these horns are developed in both sexes, although they are not infrequently confined to the males. Rarely, as in the four-horned antelope, there are two pairs.

All the above-mentioned animals are ruminants, and belong to the even-toed section of the order. Although these four types of horn structure display certain fundamental features in common, yet it is not to be supposed that any one can definitely be regarded as the

skull was almost certainly invested during life with hollow horny sheaths, thus affording evidence of the independent development of a similar structure in widely separated groups. As to the occasional presence of rudimentary paired horns in horses, no satisfactory explanation has been given, since none of the ancestors of the group shows any trace of any such structures.

In a wild state the ungulate order is well represented on all the continents of the globe, with the exception of Australia, but at the present day it has a far larger number of species in the Old than in the New World, the greater number of those from the former area belonging to groups quite unknown in the latter. Indeed, in former times the camel tribe appears to have been the dominant one in the even-toed group in North America, while hollow-horned ruminants and deer were Old World types, which only at a comparatively recent epoch gained access to the Western Hemisphere by way of what is now Bering Strait. On the other hand, horses and rhinoceroses were formerly common to both hemispheres. Although represented in the Arctic regions only by the reindeer and the musk-ox, ungulates are found alike in the coldest and the hottest regions of the globe. The maximum number of peculiar forms, as well as those of greatest corporeal bulk, are, however, inhabitants of the tropical and subtropical

THE HOOFED MAMMALS

zones; and it is also in the warmer regions that the greatest number of species occurs.

As regards the number of individuals of particular species, many ungulates far exceed any other of the larger mammals, this being especially the case with the bison that formerly roamed in countless thousands over the prairies of North America, and with the myriad hosts of springbucks and other antelopes in the South African veldt. But through the advance of civilisation and the incessant persecution of sportsman and trader, these wonderful instances of the profusion of animal life have been swept away for ever.

Not only are ungulates widely distributed in longitude and latitude, but they are also found at all elevations suitable for the existence of animal life, some of the wild sheep of the Himalaya ranging to elevations of sixteen thousand feet above the level of the sea. In time the order is an ancient one, being represented in the earliest stages of the Eocene division of the Tertiary period, although the species were mostly small, and in all cases widely different from any now living.

To the human race ungulates are far the most valuable of all mammals. With the exception of the use of dogs for sleighs in the Arctic regions, and for drawing light vehicles in certain parts of the Continent and for carrying baggage in Tibet, ungulates supply all the animals used for draught, riding, and transport purposes throughout the world. Throughout the more civilised portions of the globe the horse, the mule, and the ass are the most valuable and most generally used animals for riding, driving, and heavy draught. In other countries, however, they are replaced to a greater or less extent by oxen, buffaloes, yak in Tibet, camels, or, in South America, llamas, and, in northern regions, reindeer; while in India and Burma the elephant is a most valuable animal for draught, riding, and heavy transport.

Hoofed mammals are likewise the great source of the meat supply, and the whole source of the milk and butter used throughout the world. In the category of meat yielders the first place is occupied by domesticated cattle and sheep, next to which come goats; while in the high north the place of all three is taken, as regards the supply of both meat and milk, by the reindeer.

In the colder climates swine are a most valuable source of meat, and in South America llama flesh was, at one time, at any rate, the chief staple. Horse flesh is largely consumed in many parts of the earth, while in parts of Central Asia camels are used for food. To these sources of meat supply must be added half-wild deer kept in parks, and the flesh of wild deer, buffaloes, antelopes, and the like killed by sportsmen and traders.

The milk producers include cows, buffaloes, yak, sheep, goats, camels, llamas, and mares.

But ungulates are equally valuable as affording the only supply of wool and hair used in the manufacture of articles of apparel, and for ordinary domestic purposes. Here the foremost place is taken by the sheep, which alone yields the best kind of felting wool; after which come goats, camels, alpacas, and the invaluable reindeer. Horsehair is likewise an important product; while for the supply of bristles we are mainly indebted to the swine family.

To the last-named we also owe the leather employed in covering saddles; while the great bulk of the leather used throughout the world, other than that afforded by seals and sea-lions, is supplied by members of the hoofed order, both tame and wild.

True ivory, again, is the sole product of the African and Indian elephants, the great bulk being supplied by the former species. Hippopotamus ivory has likewise a considerable value, although not equal to elephant ivory; the only other supplies of ivory being afforded by the walrus among the Carnivora, and the narwhal among the Cetacea.

Bone, as used in manufactures, is chiefly furnished by members of the present order; the finest quality being that

of the camel, which is largely used in the inferior kinds of Indian inlaying to replace ivory.

Horn and buck's horn—that is to say, the bony substance of deer antlers—are the exclusive product of ruminants, and have important uses in manufactures. Rhinoceros horn, on the other hand, is little used in Europe, although highly esteemed and valued in the East. Lastly, the hoofs, as well as many of the horns, of ungulates, together with their tendons and sinews, afford the main supply of glue and kindred substances.



ANTLERS OF THE RED DEER

Showing the progressive increase in their size and complexity

TABLE OF UNGULATES DEALT WITH IN THIS WORK

ORDER VI Hoofed Animals—Ungulata SUBORDER 1 Even-toed Group—Artiodactyla SECTION A Cattle, Sheep, Antelopes, Giraffes, and Deer—Pecora FAMILY 1 Cattle, Sheep, and Antelopes—Bovidae GENUS 1 Cattle—Bos SPECIES Aurochs <i>Bos taurus primigenius</i> Park and domesticated cattle <i>B. taurus</i> Humped ox, or zebu <i>B. indicus</i> Gaur <i>B. gaurus</i> Bantén <i>B. sondaicus</i> Yak <i>B. grunniens</i> Bison <i>B. bonasus</i> American bison <i>B. bison</i> African buffalo <i>B. caffer</i> Indian buffalo <i>B. bubalis</i> Tamarao <i>B. mindorensis</i> Anoa <i>B. depressicornis</i> GENUS 2 Sheep—Ovis SPECIES Bighorn, or Rocky Mountain sheep <i>Ovis canadensis</i> Argali <i>O. ammon</i> Urial, or shapo <i>O. vignei</i> Red, or Gmelin's, sheep <i>O. orientalis</i> Mouflon <i>O. musimon</i> Domesticated sheep <i>O. aries</i> Bharal <i>O. nahura</i> Udad, or Barbary, sheep <i>O. lervia</i> GENUS 3 Goats—Capra SPECIES Caucasian wild goat, or ture <i>Capra cylindricornis</i> West Caucasian ture <i>C. caucasica</i> Spanish wild goat <i>C. pyrenaica</i> Wild goat <i>C. hircus agagrus</i> Sind wild goat <i>C. hircus blythi</i> Domesticated goat <i>C. hircus</i> Alpine ibex, or bouquetin <i>C. ibex</i> Sakin, or Asiatic ibex <i>C. sibirica</i> Beden, or Nubian ibex <i>C. sinaitica</i> Wala, or Abyssinian ibex <i>C. vali</i> Markhor <i>C. falconeri</i> GENUS 4 Tahrs—Hemitragus SPECIES Himalayan tahr <i>Hemitragus jemlaicus</i> Arabian tahr <i>H. jayakeri</i> Nilgiri tahr <i>H. hylocius</i> GENUS 5 Gorals—Urotragus SPECIES Brown goral <i>Urotragus goral</i> Grey goral <i>U. bedfordi</i> Ashy goral <i>U. cinereus</i> Long-tailed goral <i>U. caudatus</i> GENUS 6 Serows—Nemorhædus SPECIES Malay serow <i>Nemorhædus sumatrensis</i> White-maned serow <i>N. argyrochaetes</i> GENUS 7 Takin—Budorcas SPECIES Takin <i>Budorcas taxicolor</i> Sze-chuen takin <i>B. tibetanus</i> GENUS 8 Musk ox—Ovibos SPECIES Musk ox <i>Ovibos moschatus</i> GENUS 9 White Goat—Oreamnus SPECIES White, or Rocky Mountain, goat .. <i>Oreamnus montanus</i> GENUS 10 Chamois—Rupicapra SPECIES Chamois, or gemse <i>Rupicapra tragus</i> GENUS 11 Elands—Taurotragus SPECIES Eland <i>Taurotragus oryx</i> Lord Derby's eland <i>T. derbianus</i> GENUS 12 Bongo—Boocercus SPECIES Bongo <i>Boocercus euryceros</i>		
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GENUS 1	
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SPECIES	
Giraffe	Giraffa camelopardalis
Somali giraffe	G. reticulata
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SPECIES	
Okapi	Ocapia johnstoni
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Samotherium	Hydasphitherium
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Deer Tribe—Cervidæ	
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Hangul, or Kashmir stag	C. cashmirianus
Yarkand stag	C. yarcandensis
Sikhim stag, or shou	C. affinis
Thorold's deer	C. albirostris
Wapiti	C. canadensis
Sika deer	C. sica
Pekin deer	C. hortulorum
Formosan sika	C. taëvanus
Fallow deer	C. dama
Persian fallow deer	C. mesopotamicus
Irish deer (extinct)	C. giganteus
Chital, or Indian spotted deer	C. axis
Sambar	C. unicolor
Rusa	C. hippelaphus
Kuhl's deer	C. kuhli
Philippine spotted deer	C. alfredi
Hog deer, or para	C. porcinus
Swamp deer, or barasingha	C. duvauceli
Schomburgk's deer	C. schomburgki
Thamin	C. eldi
GENUS 2	
Muntjacs—Cervulus	
SPECIES	
Indian muntjac	Cervulus muntjac
Fea's muntjac	C. fea
Sciator's muntjac	C. sclateri
Sze-chuen muntjac	C. lachrymans
Reeves' muntjac	C. reevesi
Hairy-fronted muntjac	C. crinifrons
GENUS 3	
Tufted Deer—Elaphodus	
SPECIES	
Michie's tufted deer	Elaphodus michianus
Ichang tufted deer	E. ichangensis
Sze-chuen tufted deer	E. cephalophus
GENUS 4	
Reindeer—Rangifer	
SPECIES	
Reindeer, or caribou	Rangifer tarandus
GENUS 5	
Elk—Alces	
SPECIES	
Elk, or moose	Alces machlis
GENUS 6	
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SPECIES	
Roebuck	Capreolus caprea
Siberian roebuck	C. pygargus
Manchurian roebuck	C. manchuricus
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SPECIES	
Chinese water deer	Hydropotes inermis
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SPECIES	
Milu, or Père David's deer	Elaphurus davidianus
GENUS 9	
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SPECIES	
Pudu	Pudua pudu
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SPECIES	
Red brocket	Mazama rufa
Ecuador brocket	M. temia
Wood brocket	M. nemorivagus

Brazilian brocket	M. nana
Chilian guemal	M. bisulca
Peruvian guemal	M. antisensis
Pampas deer	M. bezoartica
Marsh deer	M. palustris
White-tailed, or Virginian deer	M. americana
Peruvian deer	M. peruviana
Mule deer	M. hemionus
Black-tailed deer	M. columbiana
GENUS 11	
Musk Deer—Moschus	
SPECIES	
Himalayan musk deer	Moschus moschiferus
Kansu musk deer	M. sifanicus
SECTION B	
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Chevrotains—Tragulidæ	
GENUS 1	
Chevrotains—Tragulus	
SPECIES	
Javan chevrotain	Tragulus javanicus
Kanchil	T. canchil
Stanley's chevrotain	T. stanleyanus
Indian chevrotain	T. meminna
GENUS 2	
Water Chevrotains—Dorcatherium, or Hyomoscus	
SPECIES	
Water chevrotain	Dorcatherium aquaticum
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Camels and Llamas—Tylopoda	
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SPECIES	
Arabian camel	Camelus dromedarius
Bactrian camel	C. bactrianus
GENUS 2	
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SPECIES	
Vicugna	Lama vicugna
Guanaco	L. huanacos
SECTION D	
Pigs and Hippopotamuses—Suina	
FAMILY 1	
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GENUS 1	
Typical Pigs—Sus	
SPECIES	
European wild boar	Sus scrofa
Indian wild boar	S. cristatus
Banded pig	S. vittatus
Formosan pig	S. taëvanus
Japanese pig	S. leucomystax
Andamanese pig	S. andamanensis
Papuan pig	S. papuensis
New Guinea pig	S. niger
Warty pig	S. verrucosus
Celebes pig	S. celebensis
Philippine pig	S. philippinensis
Bearded pig	S. barbatus
Malay pig	S. oi
Pigmy hog	S. salvanius
GENUS 2	
Bush Pigs—Potamochoerus	
SPECIES	
Bush pig	Potamochoerus choeropotamus
Red bush pig	P. porcus
Abyssinian bush pig	P. hassama
Malagasy bush pig	P. larvatus
GENUS 3	
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SPECIES	
Celebes babirusa	Babirusa alfurus
Boru babirusa	B. orientalis
GENUS 4	
Forest Hog—Hylochoerus	
SPECIES	
Forest hog	Hylochoerus meinertzhageni
GENUS 5	
Wart Hog—Phacochoerus	
SPECIES	
Wart hog	Phacochoerus aethiopicus
FAMILY 2	
Peccaries—Dicotylidæ	
GENUS	
Peccaries—Dicotyles	
SPECIES	
Collared peccary	Dicotyles tajacu
Texan peccary	D. angulatus
White-lipped peccary	D. albirostris

EXTINCT PIG-LIKE MAMMALS	
Platygonus	Dinochoerus
Chærohyus	Tetraconodon
Hyotherium	Choeropotamus
Listriodon	Anoplotherium
Entelodon	Anthracotherium
FAMILY 3	
Hippopotamuses—Hippopotamidæ	
GENUS	
Hippopotamuses—Hippopotamus	
SPECIES	
Hippopotamus	Hippopotamus amphibius
Pigmy hippopotamus	H. liberiensis
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FAMILY 1	
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GENUS	
Tapirs—Tapirus	
SPECIES	
Malay tapir	Tapirus indicus
Brazilian tapir	T. americanus
Roulin's tapir	T. roulini
Baird's tapir	T. bairdi
Dow's tapir	T. dowi
FAMILY 2	
Rhinoceroses—Rhinocerotidæ	
GENUS	
Rhinoceroses—Rhinoceros	
SPECIES	
Indian rhinoceros	Rhinoceros unicornis
Javan rhinoceros	R. sondaicus
Sumatran rhinoceros	R. sumatrensis
Black rhinoceros	R. bicornis
White rhinoceros	R. simus
Woolly rhinoceros (extinct)	R. antiquitatis
Leptorhine rhinoceros (extinct)	R. leptorhinus
FAMILY 3	
Horse Tribe—Equidæ	
GENUS	
Horses and Asses—Equus	
SPECIES	
Quagga	Equus quagga
Bontequagga	E. burchelli
Zebra	E. zebra
Foa's zebra	E. foai
Grévy's zebra	E. grévyl
African wild ass	E. asinus
Kiang	E. kiang
Tschigetai	E. hemionus
Onager	E. onager
Mongolian wild horse	E. przewalskii
Domesticated horse	E. caballus
Sivalik horse (extinct)	E. sivalensis
Steno's horse (extinct)	E. stenorhis
Hyraz Group—Hyracoidæ	
FAMILY	
Hyraxes—Procaviidæ	
GENUS	
Hyraxes—Procavia, or Hyrax	
SPECIES	
Abyssinian hyrax	Procavia abyssinica
Shoan hyrax	P. shoana
Bruce's hyrax	P. brucei
Burton's hyrax	P. burtoni
Cape hyrax	P. capensis
Syrian hyrax	P. syriaca
Kilimanjaro hyrax	P. valida
Tree hyrax	P. arborea
Liberian hyrax	P. dorsalis
Elephant Group—Proboscidea	
FAMILY	
Elephants and Mastodons—Elephantidæ	
GENUS	
Elephants—Elephas	
SPECIES	
Indian elephant	Elephas maximus
Mammoth (extinct)	E. primigenius
Columbian elephant (extinct)	E. columbianus
American elephant (extinct)	E. imperator
African elephant	E. africanus
Sutlej elephant (extinct)	E. hysudricus
Straight-tusked elephant (extinct)	E. antiquus
Pigmy elephant (extinct)	E. mnaidriensis
Maltese elephant (extinct)	E. melitensis
Cypriote elephant (extinct)	E. cypriotes
Southern elephant (extinct)	E. meridionalis
Flat-headed elephant (extinct)	E. planifrons
Ganesa elephant (extinct)	E. ganesa
Mastodon	
Tetrabelodon	
Palæomastodon	
Meritherium	
Dinothereum	
EXTINCT SOUTH AMERICAN UNGULATES	
Macrauchenia	Homalodontotherium
Oxyodontotherium	Toxodon
Protherotherium	Nesodon
Astrapotherium	Typotherium

CATTLE, SHEEP, AND ANTELOPES

THERE being no concise English term to designate collectively the animals known as cattle, sheep, goats, and antelopes, it is necessary to allude to them as the hollow-horned ruminants, unless they are called by their scientific title, *Bovidae*. This is the more to be regretted, since the term hollow-horned ruminants will likewise include the American prongbuck, which is generally regarded as the representative of a family by itself.

Taking, then, the term hollow-horned ruminants, for want of a better, to designate the animals named, this family constitutes the first representative of the even-toed section of the ungulate order. Before entering into the consideration of the especial characteristics of this family, however, we must point out those distinctive of the great group of even-toed ungulates, under which title are included not only the hollow-horned ruminants, but likewise deer, chevrotains, camels, llamas, swine, and many other living and extinct types.

The even-toed ungulates—or artiodactyles, as they are technically termed—are distinguished by the third and fourth toes being almost equally developed, and arranged symmetrically on each side of a vertical line drawn between them; this line being continued upwards to the wrist or ankle, and the metacarpal and metatarsal bones similarly arranged in respect thereto. As a consequence of this, it results that in the typical members of the group the hoofs are of the so-called "cloven" type. This character is alone sufficient to distinguish all the members of the group; but there are a few others which it is advisable to mention.

One of these characters is afforded by the cheek teeth, in which the molars are almost always more complex than the premolars. The first of the three upper molar teeth consists of two lobes, while the adjacent premolar has but a single lobe. Another feature connected with the teeth is exhibited by the last molar in the lower jaw, which almost invariably consists of three lobes; whereas in the living representative of the odd-toed ungulates it has only two lobes. In their single-lobed upper premolar teeth the even-toed ungulates show a retention, although in a highly modified and specialised condition, of the primitive triangular type of tooth, which has been lost in the molar teeth. Then, again, the thigh bone, or femur, in all the members of the present group is characterised by the absence of a projecting process—technically known as the "third trochanter"—on the hind surface of the shaft.

There are other less obvious distinctive features of the even-toed ungulates, but the foregoing are sufficient for our present purpose. It must be added, however, that both in this group and in the odd-toed ungulates there are never more than four toes to each foot; and that all the members of both groups walk on their toes alone.

After these general preliminaries, it is possible to consider somewhat more closely the characters of the hollow-horned ruminants, although it has still to be mentioned that these, together with the giraffe, the

prongbuck, and the deer, form a group distinguished from all the other even-toed ungulates by certain important characters. In all the members of this assemblage of four families there are, for instance, no front, or incisor, teeth in the upper jaw; and the upper tusks, or canines, are generally small or absent.

In the lower jaw, on the other hand, all the incisor teeth are present, while the canine tooth on each side is in immediate contact with the outermost incisor; and since all the three pairs of incisors and the single pair of canines, except in the giraffe and okapi, have nearly similar spatulate crowns, they appear to form a single semi-circular series of four pairs of teeth. This may be easily verified by examining the lower jaw of a sheep

or cow. The six cheek teeth on the sides of both jaws are placed close together; those of the lower jaw being separated by a long space from the four pairs of front spatulate teeth.

In the fore feet the third and fourth metacarpal bones, and in the hind feet the corresponding metatarsal bones, are respectively fused into single "cannon bones," while the two lateral pairs of toes are always small and rudimentary, and may be completely absent. In all the group the toes themselves are encased in complete hoofs.

Another peculiarity of this group is that the stomach is divided into four separate cavities, into the first of which the food is temporarily received, until it is regurgitated into the mouth, when it is completely masticated, and afterwards conveyed to the true digesting stomach. This process is known as the function of "chewing the cud," or ruminating; and the ungulates in which it occurs are consequently termed ruminants. This ruminating function, however, is developed in the camels and chevrotains, as well as in the assemblage of four families constituting the present group; but as the camels and chevrotains differ in several important respects, it is convenient to designate the section under consideration as the

true ruminants, or technically, the *Pecora*. The object of this ruminating power is to enable these animals, which are for the most part more or less defenceless, to take in very rapidly a sufficient supply of food on open and exposed grazing grounds, and then to retire to a safe situation where the meal may be more thoroughly masticated at leisure.

All the ruminating even-toed ungulates are characterised by the peculiar structure of their cheek teeth, which consist of four distinct columns, of which the innermost pair are crescent-shaped, with the horns of the crescents turned outwardly. In the lower jaw the molars are narrower, and with a reverse structure; that is to say, the crescents are on the outer side of the tooth, with their tips or horns turned inwardly. Accordingly the name of crescent-toothed (selenodont) ungulates is applied to all the ruminating members of the group.

It is important to observe that the true ruminants are alone characterised by the whole of the four following features, namely, no front teeth in the upper jaw, a four-chambered stomach, complete cannon bones, and the feet encased in hoofs. Moreover, it is only in the

SKULL AND HORNS OF SWAYNE'S HARTEBEEST



CATTLE, SHEEP, AND ANTELOPES

members of this group that horns are ever met with ; these appendages being always arranged as a symmetrical pair—occasionally two pairs—on each side of the middle line of the skull.

The hollow-horned ruminants, or *Bovidæ*, are distinguished from their allies by the presence of true horns—that is, of hollow and unbranched sheaths of horn growing upon bony protuberances, or cores, arising from the frontal bones of the skull ; neither the horny sheaths nor the bony cores being shed at any period of existence. In all existing wild species these horns are present at least in the male sex ; but in many domesticated breeds of cattle, sheep, and goats they are absent in both sexes ; and the same holds good for certain extinct members of the family.

Usually the molar teeth of the hollow-horned ruminants are characterised by the great relative height of their crowns, and in all cases there are no tusks or canine teeth in the upper jaw. Although in some few instances the small lateral toes may be completely absent, they are generally represented by the small spurious hooflets alone, which may, however, be supported internally by minute and irregularly-shaped nodules of bone.

The hollow-horned ruminants are chiefly Old World types, although they are represented in North America by the musk-ox, the American bison, the white goat, and the bighorn sheep. They are unknown in the southern half of the New World.

R. LYDEKKER

AUROCHS AND PARK CATTLE

Cattle, under which designation may be included not only the domesticated breeds and their wild ancestor, but likewise bisons, buffaloes, yaks, and the like, are the largest and most massively-formed members of the hollow-horned ruminants. As a rule, they are big, heavily-built animals, with very short and thick necks, and the massive and relatively short head carried nearly in the line of the back ; the males generally being provided with a large dewlap, running along the throat from the chin to between the fore legs. The tail is always long, and usually thinly haired throughout the greater part of its length and tufted at the extremity, but in the yak it is thickly haired throughout. The muzzle is broad, naked, and moist ; and there are never any "tear-pits" or glands below the eye, which are so frequently present in antelopes ; and in consequence of the absence of these tear-pits there are no depressions in the skull immediately below the eyes for their reception.

The horns, which are present in both sexes, and of relatively large dimensions in both, may be either cylindrical or more or less markedly angulated ; and are situated in the immediate neighbourhood of, or actually upon, the summit of the skull, whence they sweep in a more or less outward direction, and then curve upwards, and sometimes inwards, at their extremities. They are never twisted into a close spiral

or ornamented with prominent transverse knots. If the horn cores be cut through, they will be found to be completely honey-combed by a number of irregular cavities of large size. The upper molar teeth are very tall and broad, and provided with an additional slender column on the inner side.

With the exception of the American bison, the whole of the existing species of cattle are confined to the Old World, where by far the greater number of species are continental. There is, however, one species, of smaller size than any of the rest, restricted to the island of Celebes, and another of somewhat larger stature in the Philippines. Domesticated races are spread nearly all over the globe. The wild species inhabit either open grassy plains or dense forests, one of them being confined to the higher regions of the Himalaya and Tibet. All cattle live in herds of larger or smaller size, in which the number of individuals in some cases may be reckoned by thousands : from such herds a certain number of the old bulls separate themselves, and lead a solitary existence.

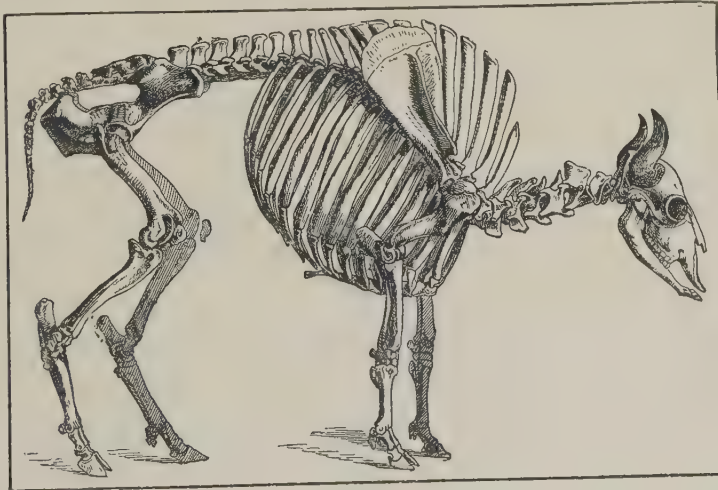
All cattle can swim readily, and some species will cross rivers of considerable breadth without the slightest hesitation. They are remarkable for their strength and endurance ; and as beasts of draught oxen are superior to horses for dragging heavy vehicles through soft and yielding ground. The usual pace of these animals is a walk, but when excited they break into a heavy and awkward gallop. Their senses of smell and hearing are acute, but their sight does not appear to be particularly keen. Their food may consist either of leaves and the tender shoots of trees, grasses, mosses, or various kinds of marsh and water plants, and all the species display a marked partiality for salt.

Usually one calf is produced at a birth, but there may be occasionally two, and, as is the case with other ruminants, the calf is born in a highly-developed state, and is soon able to run by the side of its parent.

In most of their structural peculiarities cattle are among the most highly specialised of all the hollow-horned ruminants ; and this is confirmed by the lateness of their appearance in the geological series, the group being quite unknown before the Pliocene period, and attaining its maximum development in the Pleistocene and present epochs. Prob-

ably the origin of the group may be traced to ruminants more or less closely allied to the antelopes ; and it is noteworthy that in some of the extinct species horns were present only in the male sex. The dark colour of so many of the wild species is a protective feature, a slaty hue being the one best adapted to render large animals inconspicuous.

As regards domesticated cattle, it may be remarked in the first place that there is no definite name in the English language for this species inclusive of both sexes. "Cattle," for instance, is a general term, applicable to any species of the genus *Bos*, while "bull" and "steer" respectively denote the adult and



SKELETON OF THE BISON

immature male, and "cow" and "heifer" the female. "Ox" nowadays refers to cattle used for draught or for food, but it is possible that this may have been the original term for the species, since aurochs, meaning ancient ox, was the name of the extinct wild bull of the European forests.

When the ancient wild cattle, which were probably the *urus* of Julius Cæsar, became exterminated their name was transferred to the bison, to which it long remained attached; and indeed it is only of late years that it has been restored to its proper signification. The evidence of its fossil remains demonstrates that the aurochs once ranged over the whole of Europe, as it probably also did up to nearly as late as the date of the *Nibelungenlied* (1200). The earliest portrait of the aurochs occurs on a map of the world published at Erbstorff in the closing decade of the thirteenth century; this, together with other testimony, indicating that the animal was still living at that time in Germany. By 1400, or thereabouts, it appears evident that it had been exterminated in Western Europe, as there is no reference to its existence in literature, and its name has been confounded with that of the bison. In fact, all tradition of its former existence in this part of the Continent seemed to have been lost. As it was a forest-dwelling species, the destruction of the forests, which had by this time taken place, is alone sufficient to account for its extinction.

On the other hand there is evidence that from 1404 to 1409 the aurochs was still common in Prussia and Lithuania, references occurring in old documents to captured individuals, and also to horns used as drinking vessels. That these were not bison horns is indicated by the fact that reference is made to specimens of the latter, which were likewise employed for the same purpose. Gradually the aurochs, like the bison, was driven farther and farther east by the advance of civilisation and the destruction of the forests, till it reached its last stronghold in the forest of Jaktorowka, or Wiskitki, near Warsaw, a forest which has long since disappeared.

The testimony of Count Sigismund von Herberstein, more especially that given in his "*Moscovia*," published at Vienna in 1557, leaves no doubt that aurochs were at that time living in Poland, and there is equally little doubt that the animal was seen alive by Herberstein himself. Other contemporary accounts were given by Baron Bonarus and Dr. Schneeberger, a physician of Cracow; these being quoted in Conrad Gesner's "*Historia Animalium*," published in 1551-8. From these we learn that the breeding season occurred in September, and that the calves were born in the following May. Bull calves were at first blackish brown, but afterwards became black, with a light streak along the spine. It is also stated by Bonarus that the bulls frequently paired with domesticated cows, the latter being very similar in colour to their wild relatives; while, on the other hand, it is expressly mentioned that no such intercourse took place between the wild bison and domesticated cattle.

The accounts of the aurochs do not, however, end with those of Heberstein, Gesner, Bonarus, and Schneeberger, for in 1596 Cardinal Gaetano was despatched by Pope Clement VII. on a mission to Poland, accompanied by one Paul Mucante, who left a diary, in which it is stated that the King of Poland presented the cardinal with the carcase of an aurochs from a forest where a herd was preserved. This aurochs was grey, and its flesh, when eaten, was pronounced to be very

like ordinary beef, but drier and tougher. Afterwards the cardinal paid a visit to the preserve, which was a huge enclosed forest, but although bison were seen, no aurochs made its appearance. In the diary distinction is drawn between the aurochs, domesticated cattle, and bison.

This preserve of the Polish sovereign was about two miles from Warsaw, and was the above mentioned Jaktorowka forest. As regards its wild cattle, it appears from other evidence that these were much in the same condition as the bison in the Bielovitzka forest at the present day, for they had to be supplied with fodder by keepers in winter. In 1564 the Jaktorowka herd was reported to comprise thirty head, consisting of twenty-two cows, three steers, and five calves, in addition to eight solitary bulls. By 1599 the number was reduced to twenty-four, and by 1602 to four, while in 1620 the sole survivor was a cow, which, according to the report of 1630, was alive in 1627. With the death of this cow the aurochs, as a wild animal, apparently ceased to exist.

There was, however, still a certain number existing in enclosed parks or menageries, of which the most celebrated was that of Zamosc, in Poland. Testimony to this effect occurs in a letter from Lemberg, written by Count Johann von Ostrog in 1610, and it is probable, although not certain, that some of these aurochs were living at least so late as 1627. From the evidence of Herberstein's and other pictures, together with that afforded by actual remains—inclusive of a few examples of the horns and a fragment of the skin and hair of the forehead—it is certain that the aurochs was very similar in appearance to Welsh and park cattle, although of much greater size. As regards colour, Herberstein states that the bulls were black, with a light dorsal streak. Mucante, on the other hand, describes the specimen sent to Cardinal Gaetano as grey; while in the Erbstorff map, already referred to, the coat is represented as reddish yellow (*sienna*).

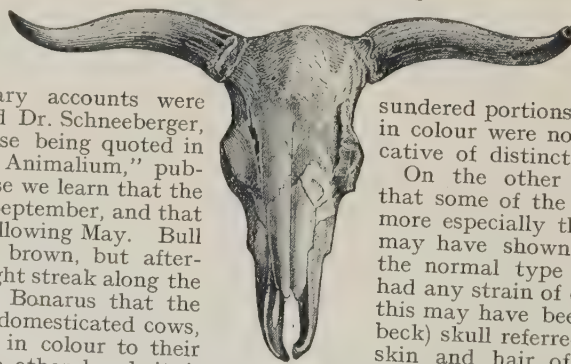
To what extent the colouring of the animals in this map is trustworthy it is difficult to decide. If, however, it be true to nature, it would seem that, in addition to the normal black form, there was a grey phase in

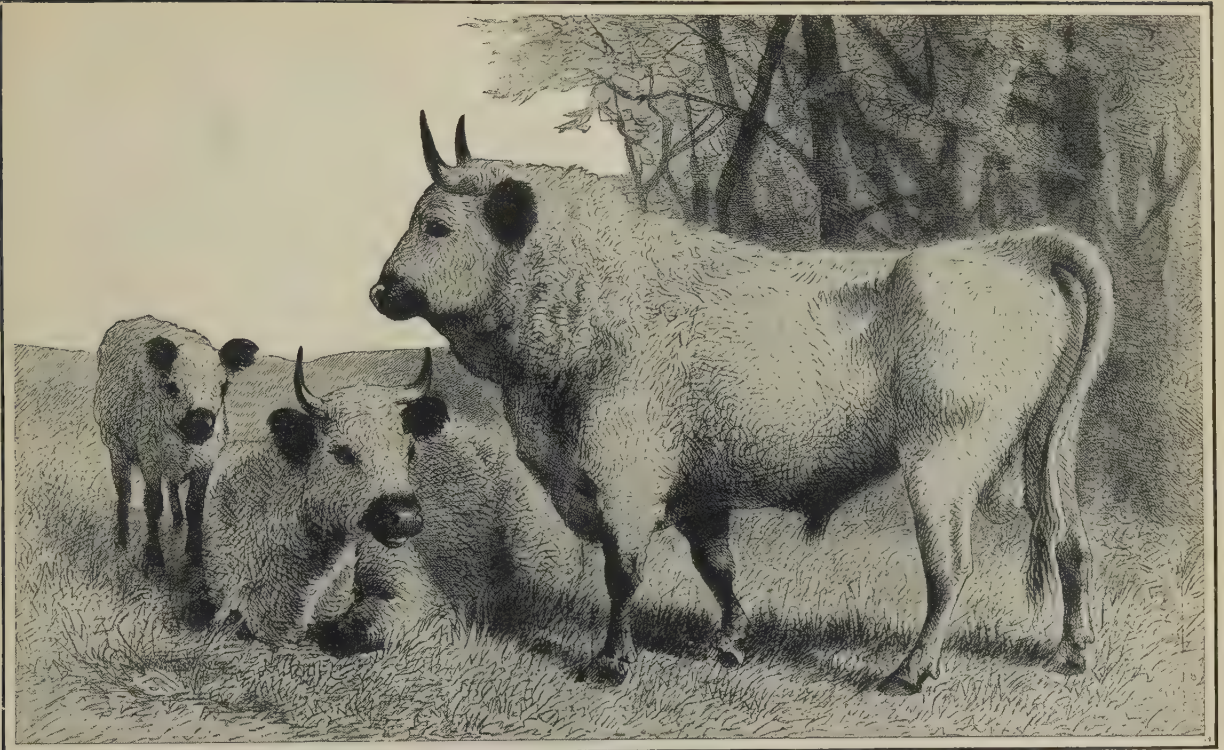
Poland and a reddish one in Central Germany. With the wide range of the aurochs and the diverse climatic and physical conditions of the more widely

sundered portions of its habitat, such variations in colour were not unlikely, and may be indicative of distinct local races.

On the other hand, it is not improbable that some of the last survivors of the aurochs, more especially those kept in enclosed parks, may have shown a tendency to depart from the normal type of colour, especially if they had any strain of domesticated blood. Possibly this may have been the case with the (Schönebeck) skull referred to as retaining part of the skin and hair of the forehead, in which the presence of long reddish hairs at the base of the back of the horns and of shorter whitish ones in front indicates that the animal was red, with perhaps patches of a paler tint, but how far this affects the general question of the colour of the aurochs is difficult to determine. Even the suggested existence of pale patches in the coat of this individual is doubtful, as whitish hairs often occur at the bases of the horn of ruminants which show no trace of white elsewhere. Possibly the cows alone were occasionally, if not always, red. Bones of the aurochs have been obtained from England and Scotland, but are unknown in Ireland,

SKULL OF THE AUROCHS





CADZOW PARK CATTLE

On the Continent they occur in France, Switzerland, Italy, Scandinavia, Germany, and Austria; while it may be taken as certain that the species roamed over Russia, although its exact eastern and northern limits are not ascertained. Southwards the aurochs ranged as far as Algeria.

The aurochs is undoubtedly the ancestor of most of the domesticated cattle of Europe, and should therefore be regarded as a race of the same species under the name of *Bos taurus primigenius*. Its nearest living English representatives are the half-wild white cattle of Chillingham and the Welsh, or Pembroke, breed. All these, together with the aurochs itself, are characterised by the horns being circular in section and placed at the extreme summit of the skull immediately over the occiput. Where they first rise from the skull the horns have their upper border convex; and the forehead of the skull is flat or slightly concave, and much longer than broad, so that the sockets of the eyes are separated by a long interval from the bases of the horns. The tail is of great length. The spines of the vertebræ of the withers are not greatly elongated, and thus do not form a distinct ridge in this region of the body.

That the wild aurochs was an animal of huge bulk is proved by the skulls and bones found in the great bogs, fens, and brick-earths of Great Britain and the Continent. In one skull the cores of the horns had a span of 42 inches from tip to tip, and when these were covered with their horny sheaths the whole could not have fallen short of 50 inches. This specimen was obtained from a peat bog in Athole, but some of the skulls found in the brick-earths at Ilford, in Essex, are of considerably larger dimensions, although from the more forward direction of their horns the span between their tips is somewhat less.

The Romans appear to have domesticated the aurochs at an early date, and produced from it in

England a small breed known as the Celtic shorthorn, of which the skulls and bones are common in deposits of Roman age. The Pembroke cattle, of which there is a black and a white breed, and the white half-wild park cattle, are the nearest living British representatives of the aurochs, although greatly reduced in size. It has been supposed that the white park breeds are truly wild cattle; but this is a complete mistake, and they are really descendants of domesticated breeds, like the albino Pembroke.

British park cattle, when pure bred, are white with the exception of the ears and muzzle, and sometimes the front of the legs, which may be either red or black, the horns being white with black tips. In size these cattle are small, but their proportions are nearly perfect, the head being small, the back straight, and the legs short. The only herds now remaining are those at Cadzow, Chillingham, Lyme, and Somerford.

The best known of all is the Chillingham herd. There is some doubt as to the date of the enclosure of Chillingham Park, which, however, very probably took place early in the thirteenth century; and there is undoubted evidence of the existence of the herd rather more than two hundred years ago. The Chillingham cattle are small, with moderately rough and curly hair, and short upwardly-directed horns. At the present day the insides of the ears and the muzzles are red; but it appears that in 1692 black ears were more numerous than red, and that the present colouring has been produced by selection.

The Cadzow cattle, belonging to the Duke of Hamilton, differ from the Chillingham breed in having the ears and muzzles black, while there is also a greater or smaller amount of black on the front of the fore legs. Their heads are also more rounded, and their limbs stouter, and very generally the cows are devoid of horns. This herd is very ancient.

Very different in appearance from either was the Chartley breed, which is now extinct. It is known that these cattle were the descendants of half-wild cattle which roamed at large in the forest of Needwood at the date of the enclosure of Chartley Park in 1248. In this breed the ears were black, and the horns longer and directed much more outwardly than in the Chillinghams. The breed thus approached the longhorns, to which it was doubtless nearly related. Black calves frequently occurred; and, as in the case of the Chillinghams, indicate that the breed was originally dark-coloured. In the Lyme Park breed, interesting as being of larger size than any of the others, the hair is remarkable for its length and curliness, more especially on the shoulders; the ears are generally red, although occasionally black or bluish black, and the horns intermediate between those of the Chillingham and Chartley breeds.

The breed at Somerford Park, situated in the heart of what was formerly Maxwell Forest, was thus described by Mr. J. E. Harting: "An ancient herd of white cattle, resembling those at Chartley, but polled, still exists here; and these animals are considered to be the best surviving representatives of the hornless and tame variety of the original wild white breed. The colour is pure white; the ears, rims of the eyes, muzzle, and hoofs being quite black. Like all other herds of the forest breed they have a strong tendency to produce small black spots on the neck, sides, and legs."

The various herds of white park cattle, according to the works of the old chronicler Fitz-Stephen, dating from about 1174, were derived from a half-wild domesticated breed common in the forests around London, and probably, therefore, in other parts of England. When the various parks were enclosed, a certain number of these cattle was driven in, and the herds thus obtained were preserved with more or less care by their subsequent owners. R. LYDEKKER

DOMESTICATED CATTLE

The ox (*Bos taurus*) has been domesticated from the very earliest period of human society, and it is probable that it had a civilising effect in inducing men to settle down from a savage state. Ancient records and sacred writings point to the fact that primitive man in his nomadic or pastoral life was associated with domesticated animals, and the wealth of the first people was estimated by the numbers of their flocks and herds. In the book of Genesis, Jabal, the son of Lamech, is mentioned as being the father or ancestor of "all such as dwell in tents and have cattle"; and the ox is referred to in several places as one of the most valued possessions of the early patriarchs.

Economically, the value of cattle is literally inestimable. Not only is beef the principal article of food

in many countries, but of recent years a number of industries have sprung up, such as the tinned beef industry in the United States and elsewhere, for preserving and making extracts of the flesh of the ox for human consumption. Milk, butter, and cheese are necessities of life, and dairying has developed to such an extent that in the United Kingdom it is regarded as the farmers' mainstay during periods of depression in the agricultural industry.

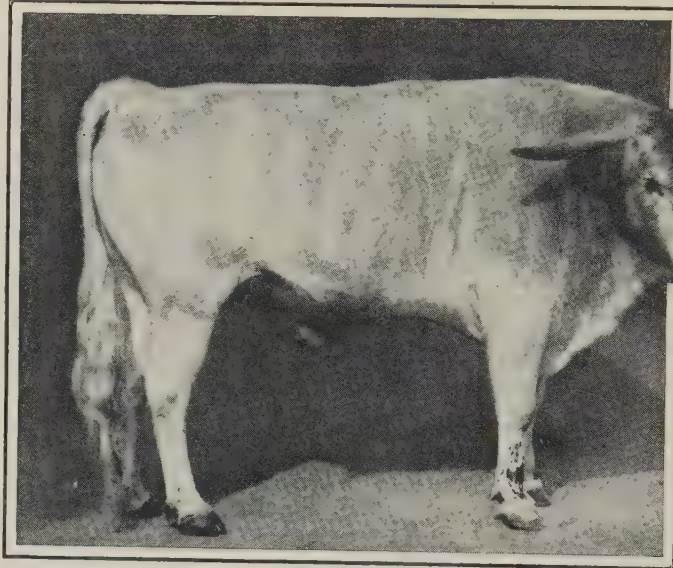
In addition to milk and beef, practically every part of the carcass of the ox can be put to some useful purpose: thus the hide goes to the tanner; the horns, bones, and hoofs are used for the manufacture of knife-handles and glue; and the refuse, together with the blood, is made into manure; while the hair is also used in making plaster.

Nor is the use of the ox as a beast of draught by any means unknown even in England. At the present time teams of oxen may be seen at work on certain farms in the Cotswold district of Gloucestershire, and teams of working bullocks are regularly employed on Lord Bathurst's home farm at Cirencester.

All evidence goes to show that the aurochs (*Bos primigenus*) was the ancestor of all the long-horned, short-horned, and hornless breeds of cattle in Europe. At the time of the Roman occupation the Celtic short-horn (*Bos longifrons*) was the only domesticated breed of cattle in Britain. Subsequently cattle belonging to the urus family were introduced by the Teutonic invaders at various periods and crossed with the native cattle. We may thus take it that the present breeds are descendants of these two races blended at different times. As the conquering tribes with their cattle settled first in the east or south of England, the Celtic shorthorns were gradually pushed into the mountainous districts of the north and west, and their descendants may now be seen in the West Highland, Welsh, Kerry, and Devon and Sussex breeds. The gradual development of the special points and characteristics of existing breeds have, therefore, been largely influenced by climate, soil, and environment.

PRINCIPLES OF BREEDING.

Great improvements have been made in the breeds of live stock in the United Kingdom during the last hundred years, and many advances have taken place in the art of breeding. This has been due to the instinctive knowledge of the characters of first-class stock possessed by breeders following on the principles set forth and practised by Robert Bakewell (1725-95), of Dishley, in Leicestershire. The teachings of modern science have also been of marked assistance to the breeder, and there is little doubt that experiment and research, carried out on proper lines, will play an important part in the future in developing and furthering the interests of the breeding industry.



A CHARTLEY PARK BULL

From a photograph by Mr. Gambier Bolton, by permission of the Autotype Co., 74, New Oxford St., W.C.



HIGHLAND CATTLE: FROM THE PAINTING "MOORLAND ROVERS," BY PETER GRAHAM, R.A.

On account of its picturesque appearance, this breed is often made use of as park cattle in England. Their home, however, is Argyllshire and the western islands of Scotland, where they live under natural conditions."



INDIAN BUFFALOES

... The haunts of the wild Indian buffalo are the tall grass-jungles found in many parts of the plains and generally in the neighbourhood of swamps; but it may also be found more rarely in the open plains of short grass, or among low jungle, and occasionally even in forest.



BHARAL

... The herds keep to high, open ground above forest and never even enter bush. Owing to their colour, it is peculiarly difficult to make them out when they are lying down among stones.



MOUFLON

"One of their favourite devices is to seek for spots on the lee side of a ridge where the currents of air meet. Here, in otherwise favourable positions they are quite unapproachable."

DOMESTICATED CATTLE

Although no hard and fast rules can be laid down for the guidance of the breeder so that he can produce stock "to order" of any particular type required, still there are certain laws or principles applicable to all classes of domesticated stock which may be relied on to a large extent, and which are worth discussing briefly.

HEREDITY AND VARIATION. The first of these principles may be stated in the phrase "like begets like," and this is accountable for what we know as "family likeness." That is to say, the offspring of two parents will probably show some of the characteristics of each of them; or, in other words, be of an intermediate or hybrid type, although this is not always the case. This is frequently seen in human beings. In the case of animals, therefore, within certain limits, whatever peculiarities the sire and dam possess may be looked for in the offspring; slight variations, however, will always be noticeable.

In the case of domesticated animals there is no struggle for existence, and the "artificial selection" of the breeder takes the place of "natural selection." In these circumstances the owner retains those animals for breeding which show desirable characteristics and conform to the type he wishes to establish. Such

CROSSING. When the sire and dam of two distinct breeds are crossed, the offspring generally shows the good points of both. Some of the best fattening stock is produced in this way. Thus a white shorthorn bull crossed with a Galloway cow produces the "blue grey" so much sought after for feeding purposes in the north of England. With pigs, a cross of the large white Yorkshire and the Berkshire produces a pig easy to feed and greatly favoured by the bacon-curers.

For this purpose it is not wise to go beyond a first cross, however, as undesirable characteristics then begin to make their appearance.

Crossing has occasionally been made use of in the past in the formation of new breeds, as in the case of the Oxford down sheep.

PREPOTENCY. Animals that have been bred to a certain type for a number of generations have a great power of stamping their qualities on stock that have not been so well bred. This power of prepotency, as it is called, is often made use of for improving a herd of ordinary cows by using a pedigree bull, and much loss has occurred in the past through dairymen begrudging a few extra pounds when purchasing a bull



A TEAM OF HEREFORD AND SHORTHORN OXEN PLOUGHING

Photo, C. Reid

methods were followed in most of the improved breeds during the nineteenth century, and the coarser points and slow-growing habits were got rid of, while desirable qualities, such as milking, flesh-producing, and wool-bearing powers, were developed, although in some cases at the cost of the constitution of the animals.

One property which has been specially developed is early maturity, which causes animals to be ready for market at an earlier age than formerly. Thus bullocks are now fattened at the age of from twenty to thirty-six months; instead of at from four to seven years old as formerly. Fat sheep are now ready for the butcher under a year old, and pigs are fattened at the age of eight to ten months, instead of running on till twice that age as used to be the custom.

IN-BREEDING. It is possible to hasten the process of development by selection and breeding from closely related animals. This helps to fix a certain type, but when carried too far results in great loss of constitutional vigour, combined with loss of size and sterility. In-breeding was made use of by the founders of the present breeds to fix a definite type, but it must not be pressed beyond a certain point.

for the use of their herd. Prepotency may also be made use of in the breeding of beef animals, as when a shorthorn bull is mated with cows of the slower maturing breeds, as Kerry, Ayrshire, or Galloway.

REVERSION. In improved breeds that have been bred on definite lines for a number of years, the points are fixed, and they are capable of transmitting them. Occasionally, however, some characteristic not possessed by the immediate parents appears in the offspring, as the sudden appearance of horns in the calf of a polled breed, or hair and a dark colour in the fleece of a sheep of a good flock. This appearance of some point not possessed by the parents is called "reversion," "atavism," or "throwing back" to some characteristic of the original ancestors of the breed. Crossing always has a tendency to encourage this.

APPLICATION OF MENDEL'S LAW. Before leaving the subject of breeding, we must consider the practical application of Mendel's laws of inheritance, which, since their rediscovery, have been tested both with plants and animals. Gregor Johann Mendel (1822-84) carried out his investigations in cross-breeding, using

plants for the purpose of his experiments, about the middle of the nineteenth century, and his theories explaining his results were published in 1865. Little attention, however, was paid to the matter at the time, and it was not till later that the value of his work was recognised, and numerous trials were instituted to test his statements. The most important of these experiments, carried out by Professor R. H. Biffin at Cambridge on the cross-breeding of wheats, confirmed Mendel's views: and much light has been thrown on many hitherto somewhat obscure points connected with crossing.

The old idea with regard to crossing different varieties of plants was that the act of crossing produced a large amount of variation or sporting in the offspring, and that a fixed type could only then be obtained in a rather haphazard fashion by a tedious process of selection. Professor Biffin, working on Mendelian lines, however, has clearly shown that crossing does not give rise to miscellaneous progeny, but that the offspring of the second and subsequent generations are produced in a definite order and in a fixed ratio.

In estimating results it is necessary to take into consideration the potency of the pairs of unit characters of the two parents and the extent to which these are capable of being transmitted to the progeny in the second and following generations. Accordingly, while some pairs of unit characters have equal potency and will be evenly divided in the offspring, in other pairs one unit character will hold mastery over and tend to obscure the other. In this latter case the first unit character is said to be "dominant" over the second and the second is said to be "recessive" to the first.

As equally interesting results have been obtained with animals as with plants in testing the law, we will take the case of the colour in cattle to illustrate the point. Thus, if pure red and pure white cattle are bred together, the following results may be expected in the colour of the offspring:

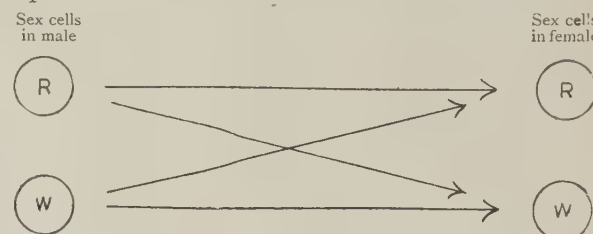
	Red				White
First generation	Roan (hybrid)				
Second generation	Red (25 per cent.)	Roan (50 per cent.)		White (25 per cent.)	
Third generation	Red (pure bred Reds)	Red (25 per cent. pure)	Roan (50 per cent. hybrid)	White (25 per cent. pure)	White (pure bred Whites)

From this we see that in the case where a red and a white parent, whose colours are of equal potency, are mated the offspring will be a roan, or, in other words, a hybrid blending the two pure colours. If two of the roans are bred together some of the calves will be red, others roan and others white, in proportion of 1 : 2 : 1, or red 25 per cent., roan 50 per cent., and white 25 per cent.

If, then, the reds are bred together they will produce pure-bred reds; the whites likewise bred together will give rise to pure-bred whites; but the roans of the second generation, on the other hand, if mated, will give reds, roans, and whites in the proportion of 1 : 2 : 1.

The Mendelian explanation of these results is that the hybrid carries from the beginning the sex cells or determinants which will decide the colour and other characteristics in a pure and not a blended condition. The determinants are produced in approximately equal

proportions, and some of these carry the red character and others the white. The chances of combination when roan crosses are bred together will then be as represented in the following diagram, supposing R to represent the character for redness and W for whiteness:



The combinations possible, therefore, are R R producing red animals; W W producing white animals; R W, W R giving rise to roan animals intermediate in colour. No other combinations except these four are possible, a fact which accounts for the ratio 1 : 2 : 1.

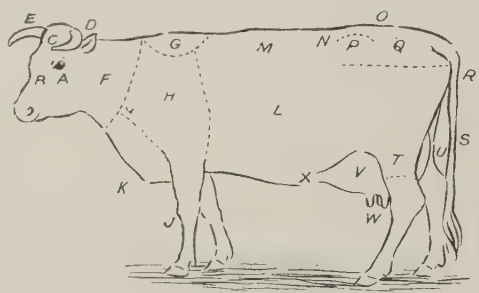
Similar results to the above have been obtained in crossing "dense" and "lax" eared wheats; the hybrids from the first cross in the second generation producing plants with lax, intermediate and dense ears in the proportion of 1 : 2 : 1. The seed from these three types in the third generation showed the lax and dense ears to breed true, but the intermediate ears to again split up, producing lax, intermediate and dense ears in the proportion of 1 : 2 : 1.

We will now take a more complex case where one colour, as black, is dominant over another, as red. If then, pure black and pure red cattle are bred together the results as set out in the following table may be expected:

	Black				Red	
First generation		Black (hybrid)				
Second generation	Black (pure)	Black (hybrid)	Black (hybrid)		Red (pure)	
Third generation	Black (pure bred Blacks)	Black (pure)	Black (hybrid)	Black (hybrid)	Red (pure)	Red (pure bred Reds)

Here the hybrids of the first generation will be black, following the colour of the dominant parent, although certain of the sex cells will still retain their character for redness, but in a hidden form. If these hybrids are mated, the dominant colour (black) will appear in the offspring in the proportion of three to one, whilst one fourth of the calves will be of the recessive colour (red). Only one of the blacks—one fourth of total offspring—however, is pure, and the other two—or one half of total offspring—are really hybrids, although assuming the dominant colour externally. The pure blacks and reds of this second generation if bred together will throw blacks and reds true to type respectively; but the hybrid blacks, if mated, will again produce blacks and reds in the proportion of three to one, only one of the former, however, being pure black.

These examples, taking colour as the character to be experimented with, will serve to explain the main principles of the law, but, as may be imagined, where more than one pair of characters are present in the parents the transmission of these to the progeny is of a



THE POINTS OF THE COW

a, Eye; b, face; c, forehead; d, ear; e, horn; f, neck; g, top of shoulder; h, shoulder; i, knee; k, dewlap; l, ribs; m, back; n, loin; o, rump; p, hip; q, quarters; r, tail; s, switch; t, thigh; u, hock; v, udder; w, teats; x, abdomen and milk vein

BREEDS OF CATTLE

more complicated character, and leaves a wide field for investigation and research.

CROSSING OF SUFFOLK AND DORSET HORNED SHEEP. One of the most interesting experiments on Mendelian lines with animals is that which has been conducted at Cambridge by Professor Wood on the inheritance of the face colour and horns in sheep. The breeds selected for the trial were Suffolks and Dorsets, the former having black faces and no horns, the latter white faces and horns in both sexes. A number of Suffolk ewes crossed with a Dorset ram produced lambs all of which had speckled faces. The cross was also made in the opposite direction with a similar result. The hybrid lambs of this first cross must, therefore, be described as intermediate as far as facial colour is concerned.

The following table will show the results obtained in the subsequent progeny:

	Suffolk (black faces, no horns)	Dorset (white faces, horns in both sexes)
<i>First generation</i>	(Speckled faces.)	Intermediate Males horned. Females hornless)
<i>Second generation</i>	White-faced (horned or hornless)	Speckled-faced (horned or hornless)
		Black-faced (horned or hornless)

It will be seen that, when the hybrids of the first cross were bred from, lambs with white, speckled, and black faces were secured. It thus appears that the result of mating the hybrids is to produce once again the characters of the parents, together with a further type of hybrid. This result is on a par with that obtained by crossing lax and dense-eared wheats.

Taking the question of horns into consideration, we find that the males are horned and the females hornless. With the second cross, the black or white or speckled individuals may be horned or hornless. The point to be noted, therefore, is that if it were desired to establish a pure breed from the offspring of this second cross there would probably be no difficulty in the matter, as the white and black faces would, without doubt, at once breed true to these characters, and attention would only have to be directed to the horns.

How far the results of these tests may be applicable to cattle and other classes of farm stock remains to be seen, but indications point to far-reaching effects, and the application of the principles thus demonstrated may play an important part in developing the stock-breeding industry during the next few decades.

BREEDS OF CATTLE

As has already been stated, British breeds of cattle are probably the descendants of the aurochs and the Celtic shorthorn, which have been blended in various ways since the time of the Roman invasion. The gradual development of the characters and points of the various breeds as we now know them has been largely influenced by the climate, soil, environment, and other special

conditions. In deciding on a form of classification, therefore, one based on the locality in which the breeds are found seems to be more intelligible than any other.

ENGLISH BREEDS				
<i>General Purpose Breeds</i>				
Shorthorn		Red Poll		South Devon
<i>Beef Breeds</i>				
Hereford		North Devon		Sussex
<i>SCOTTISH BREEDS</i>				
Ayrshire		Aberdeen-Angus		Zetland or Shetland
West Highland		Galloway		Cattle
<i>WELSH BREED</i>				
Welsh Black				
<i>CHANNEL ISLANDS BREEDS</i>				
Jersey Guernsey				
<i>IRISH BREEDS</i>				
Kerry Dexter Kerry				

ENGLISH BREEDS

THE SHORTHORN. This is the most important and most widely distributed of all British breeds. Not only does it provide the usual type of cattle common in the country, but, owing to its excellent qualities and adaptability to climate, it has found its way all over the British colonies, as well as the United States and South America. Indeed, it is held in so much esteem that foreign buyers are continually taking the best of our British-bred stock to improve their herds and cross with their native cattle.

If a visit be paid to one of the principal markets in the United Kingdom, it will be seen that, except in a few localities, the majority of the cattle exposed for sale are of the non-pedigree shorthorn type; and, in fact, it may be said that the shorthorns in number equal, if not exceed, all the other breeds in the British Isles put together. When we consider that the shorthorn is the general class of animal found on the farms all over England, we understand the necessity for its being bred on general utility lines, so that when it has finished its period of milking it may be capable of

being turned into a good carcase of beef, thus causing little loss to its owner. Under these circumstances, breeders who endeavour to convert the shorthorn into a beef or milk animal only are working on the wrong lines, and it cannot be too strongly pointed out that the animal required is a dual-purpose cow which can profitably go to the butcher when its services are no longer required in the dairy.

The colours most favoured in the shorthorn are deep roans and reds of various

shades. Red and whites and also pure whites appear, but there is a prejudice against the latter colour. The nose should be flesh-coloured; and a black nose is objectionable, as it is considered to denote impurity.

The horns should be short and blunt, of a creamy colour, and free from black tips. Very little seems to be known of the early history of the breed, except that it originated in the north-east of England, and at one time a strain of Dutch blood was probably introduced.

Towards the end of the eighteenth century the brothers Charles and Robert Colling began their improvement of



A SHORTHORN BULL

Photo, Vinton

HARMSWORTH NATURAL HISTORY

the breed as it then existed by a process of in-breeding, and one of their bulls, called "Hubback," may be looked upon as the father of the present improved shorthorn.

Two well-known breeders, Thomas Bates, of Kirkclevington, and Thomas Booth, of Killerby, then came on the scene, and the two great branches of the shorthorn breed are named after them respectively. The descendants of the Bates' cattle are noted for their style, quality, and deep milking propensities; whilst those of the Booth strain are famous for their great girth, deep carcasses, and beef-producing power.

Of recent years a Scottish strain of shorthorns has come much to the front remarkable for their constitution, massive frames, and early maturity. These are sometimes spoken of as Aberdeenshire shorthorns, and are associated with the name of Amos Cruickshank, the original founder of the strain. The type of shorthorn in demand, especially with foreign buyers, is one of Scottish descent blended with a certain amount of Bates' blood for the object of maintaining quality.

LINCOLN RED SHORTHORN. A special strain of red shorthorns has been established in Lincolnshire, and a herd book has been started in order to develop their milking qualities by selection. They are large-framed animals, rather coarse in the bone, but well suited to the better classes of soil.

RED POLL. This small, compact, modern breed without horns is found in Norfolk and Suffolk. The colour is red, with a white tip to the tail. It is specially noted for its combined qualities of beef and milk, and originated in a cross between a local breed of Norfolk horned cattle and the old Suffolk polled cattle, which were renowned for milking properties.

SOUTH DEVON (or SOUTH HAMS). The home of this breed is in South Devon and Cornwall. They are large-framed and big-boned animals, rather inclined to be coarse, but with good udders. The South Devon is of a yellowish tint, being distinctly lighter in colour than the neatly-built North Devon, and the type reminds one strongly of the Guernsey.

It seems probable that the two Devons were descended originally from a common stock, but that climate and local conditions have developed the southern branch on its modern lines as a dual-purpose cow. They are heavy milkers, and are also capable of yielding a large carcass of beef. For these reasons they are becoming very popular, and are beginning to be exported abroad.

HEREFORD. The Hereford is one of the best-known of British breeds, and is widely distributed in America and Australia. As far as points are concerned, the colour is light to dark red, with white markings along the spine, face, throat, belly, udder, and tip of tail. The muzzle is flesh coloured, and the horns are of medium length, white, with a slight tinge of yellow. The Hereford is an excellent grazing bullock, and in this capacity large numbers may be seen in the summer on the rich feeding pastures of the English midlands. They are indifferent as milkers, and the calves are

usually allowed to run with the dams. However, an effort is being made to develop a dairy type. In the past the breed produced good working oxen, but only in very rare instances are they now used for this purpose.

NORTH DEVON. This important breed is found in Devon and parts of Somerset and Dorset, and the cattle are sometimes spoken of as the "Rubies of the West." Their general neatness and symmetry of form have earned for them the name of "Southdown" among cattle. The carcass is smaller and more compact than in the case of the Hereford or Sussex, and is much liked by butchers. There are two distinct types of North Devon—"the true North Devon," which is of a deep red, with white hairs on the udder and tip of the tail; the skin orange yellow; creamy white horns, black tipped, and curling upwards in the case of the cow; and the "Somerset type" of Devon, lighter in colour and coarser in carcass and horn.

As in the case of the Hereford, this breed was much used at one time for purposes of cultivating the soil.

SUSSEX. These cattle resemble the Devons in many respects, and it seems probable that they are also the more or less direct descendants of the Celtic shorthorns. The colour is dark red, dusky than in the North Devons, and they are also larger in frame and somewhat coarser than the latter breed. The Sussex was much improved during the nineteenth century, and its early maturing properties were enhanced. Fine specimens of bullocks of this breed are grazed during the summer on Pevensy Marshes, between Eastbourne and Hastings, and, with their long, strong horns, are a well-known feature in that neighbourhood. The beef is of first-rate quality when the animals are thoroughly finished, and excellent results have been obtained with these cattle at the Smithfield Show in London.

LONGHORN. These are the remains of an old breed, at one time widely distributed over the British Isles.

In many ways they resemble the shorthorn, the colours being the same, but they are distinguished from them by their long, down-curving horns. A few herds are still in existence, as in some parts of the midlands. This is the breed that Robert Bakewell selected for improvement by his method of in-breeding, but since his time they have been supplanted by the shorthorn.

SCOTTISH BREEDS

AYRSHIRE. This is the noted dairy breed of Scotland, the milk



A SOUTH DEVON COW

Photo, Vinton

being specially adapted for purposes of cheese-making. Their home is Ayrshire and the neighbouring counties. The breed is characterised by a peculiar curve upwards of the horns, and the colour is usually white and red, or white and brown, the patches being distinct. They have beautifully-shaped udders of large capacity, long and shallow, with small teats, and carried well forward and up behind. The cattle make indifferent feeders after they are past milking, but during their prime they never fail to produce a large flow of milk off inferior pastures.

IRISH BREEDS

HIGHLAND (WEST HIGHLAND OR KYLOE). On account of its picturesque appearance (page 625) this breed is often made use of as park cattle in England. Their home, however, is Argyllshire and the western islands of Scotland, where they live under natural conditions. The colour varies from creamy yellow to brown and black; the coat is long and shaggy, and the horns are set wide apart. It is the hardiest of all British breeds, but the animals are slow in coming to maturity, although the beef, when grown, is of first-rate quality.

ABERDEEN-ANGUS. These cattle are natives of Aberdeenshire and the north-east of Scotland, and used at one time to be spoken of as "doddies." The colour is a whole black, with hornless head and poll coming to a "peak." They are hardy, low-set, deep-framed cattle, which kill well, and, on account of the attention paid to them in recent years, come earlier to maturity than the other Scottish breeds. They are noted for the quality of their flesh and symmetry of form, and win many prizes at the leading fat stock shows.

GALLOWAY. The habitat of this breed is the south-west of Scotland. They have particularly strong constitutions, as they have not been in-bred, and are consequently slow in coming to maturity. It is a polled breed, with the crown more rounded than in the case of the Aberdeen-Angus. They are also rather smaller and rougher in the coat than the latter breed. The colour is generally black, but reds and browns may appear. The breed crosses well with the shorthorn, and a white shorthorn bull mated with Galloway cows produces the "blue greys" famed for feeding qualities.

ZETLAND OR SHETLAND CATTLE. These are a small, hardy breed, black and white in colour, found in the Shetland Islands. They may be looked on as a mountain breed living under natural conditions, and have been little improved.

WELSH BREEDS

At one time Wales could boast of several breeds of cattle, and some of these are still extant. Up to a short time ago two principal black breeds were recognised, and had herd books of their own—the North Wales, or Anglesey black, and the South Wales—but these two breeds have now been merged under one society known as the "Welsh Black Cattle Society," with one herd book and one special type selected as a standard.

NORTH WALES. This breed, which comes from Anglesey and North Wales, is more particularly noted for its beef-producing qualities, and its horns are whiter and not quite so long as in the South Wales type. These cattle supply the store cattle in so much demand in the English midland counties for grazing purposes, and pass under the name of "runts." They are somewhat slow-growing, but, when well finished, kill out to great weights, forming excellent carcasses of beef.

SOUTH WALES. This breed has a reputation for the production of milk, notwithstanding that they have somewhat coarse frames, and are slow in coming to maturity. They thrive and milk well on poor hill pastures.

The Welsh breeds generally have a good reputation in the south of England both for milk and beef production in spite of being somewhat slow growers. They are also becoming a very popular breed in America.

CHANNEL ISLANDS CATTLE

These cattle were for many years imported into England under the name of "Alderney," although the animals from this island have always been the least important of the three sections.

JERSEY. The cattle from this island have been bred pure for a number of years, owing to the strict regulations against the importation of foreign blood. They are graceful, deer-like cattle, with slender frames, large lustrous eyes, delicate ears, lined with orange-tinted skin, and horns curved forward, with black tips (page 638). The colours most in

vogue are fawn or silver-grey, with black points. The breed is noted for its rich milk, with high butter-ratio, but the animals are of little use for feeding purposes. There are two distinct types of pure-bred Jersey—the small, delicate Channel Islands type, and the coarser English-bred and acclimatised animal.

GUERNSEY. In general appearance the Guernsey (page 638) differs from the Jersey, being a larger and somewhat coarser-boned animal. The colours also are broken and in patches, white appearing in the light yellow or brown. The noses are flesh-coloured. This breed is also noted for the high quality of its milk, which is even richer than that of the Jersey.

IRISH BREEDS

The bulk of the cattle in Ireland are shorthorns, and the Irish Department of Agriculture and Technical Instruction has taken much pains to improve the type throughout the country by the distribution of "premium" pedigree bulls in various districts. Under this treatment the character of Irish store cattle, imported in such large numbers into Great Britain, has improved.

KERRY. The home of this small and hardy native breed is in the south-west of Ireland, and owing to their many good qualities they have spread in many directions. They thrive well on poor pastures, and give a large flow of milk in proportion to their size. The colour is black, with a splash of white on the udder, and the skin should be of an orange tint. The horns are white, wide apart, black-tipped, and curving upwards. The breed is somewhat slow in coming to maturity, and is principally recognised for its dairy qualities (page 639).

DEXTER KERRY. This is a fancy breed which has been developed by selection from the Kerry. The shape is like a shorthorn in miniature, and the animals are smaller, shorter-legged, and more substantial than the



A HEREFORD BULL

Photo, Vinton

HARMSWORTH NATURAL HISTORY

ordinary Kerry. The colour is black, although red sometimes appears, and one characteristic of the cows is the enormous udders carried close to the ground. The cattle have a reputation for producing excellent carcasses of small beef.

REARING, FEEDING, AND GENERAL MANAGEMENT

SELECTION OF STOCK. Domesticated cattle in the United Kingdom are reared with the two special objects

choice by the aid of an instinctive and in some cases a marvellous knowledge, handed down to them by their fathers, of the good and bad points of cattle. If asked by the uninitiated why one animal is better than another, or why they know that one animal will feed quicker than another, they will often be unable to explain; but the fact remains that the appearance of the animal gives them an intuitive impression of its qualities. There are indications, however, as in the

case of other animals, that will give the careful observer some idea as to the feeding or milk-producing qualities of any particular beast. Thus, the power of any animal to make the best use of its food in assimilating nourishment for the production of fat in a beast intended for feeding, or for the manufacture of milk in a dairy animal, will depend very much on its possessing large and healthy digestive and respiratory organs. A wide and deep chest and a capacious barrel are, therefore, to be looked on as indications of an animal's ability of quickly secreting fat. This property is also shown by a fineness of the bones of the extremities in the head, limbs, and tail, and an animal showing coarseness in these points should be passed over. Another very important point is the touch, and if a portion of the skin over the ribs be raised between the thumb and forefinger and it feels soft, mellow, and elastic it is a sure sign of the property of secreting fatty tissue. A hard, inexpansive skin, on the other hand, shows a slow feeder.

The following may be taken as the chief indications of the qualities of feeding in cattle:

HEAD AND NECK. The head should be fine, not coarse; broad between the eyes; the face moderately short, with the muzzle broad and dewy. The horns should be fine, varying according to breed; the ears full and sensitive; the eyes clear and mild. The neck should be clean, large where it joins the shoulders and breast, and tapering to the head.

FORE QUARTERS. The chest should be wide and deep, with the breast projecting well in front of the fore limbs; the shoulders broad, neat, and open, giving a good width over the crops.

BODY. The girth behind the shoulders should be large; the back and loins straight, wide, and flat from chime to rump; the ribs well arched and deep.

HIND QUARTERS. The hook bones should be well set and nearly on a level with the backbone; there should be a good length from the hook bone to the pin bone, so as to form a long, broad, and straight quarter; the tail head should be on a level with the back and broad, the tail itself tapering towards its extremity; the twist or inner thigh should be full and large.

LEGS. The legs should be short and well-fleshed to the knee or hock, but below these joints the bones should be fine and flat, and the hoofs small.

SKIN. When handled the skin should be mellow and soft to the touch, and should at the same time be covered with soft hair.

A careful study of the above points will give the intending purchaser some information with regard to the future feeding properties of a store beast; but it must be remembered that it is always more difficult to be a judge of store cattle than it is of fat ones. The fact that an animal is fat and ready to go to the butcher is generally apparent to the observer, although some skill is required in forming a correct judgment as to quality; but in the case of purchasing store beasts one has to judge their future capabilities from present appearances.



A NORTH DEVON BULL

Photo, Vinton

of milk and beef production. Which of these two commodities it will pay the farmer best to provide depends very largely on the circumstances in which he is placed. Questions of soil, climate, situation, marketing facilities, cost of production, and the value of the finished article must all be taken into consideration in determining what course it is best to adopt. In the vicinity of large towns and also in thickly populated districts—as in North Cheshire, South Lancashire, and the home counties round London, where the land is suitable for dairying, the new milk trade will probably pay better than anything else. On dairy farms in more remote parts of the country, especially where there is a large surplus of summer milk, the manufacture of cheese, although involving extra labour, will generally prove the more remunerative. Butter-making will answer where there is a good market, but the price has ruled so low of late years that many farmers have given up the production for some better-paying branch.

In districts where the conditions are suitable, feeding for beef takes the place of dairying; thus, on the rich feeding lands of the English midlands and some other parts of the country the staple industry is the grazing of bullocks during the summer months when there is a flush of grass. On large arable farms it is often the custom to feed a number of beasts in stalls and yards during the winter with the double object of converting the roots and fodder grown on the farm into cash in the form of beef and at the same time of treading down the straw into manure for use on the holding.

In other cases, especially in hilly districts, stock-rearing with a view to providing for the future wants of the grazier and the dairyman is the chief industry. It will thus be seen that the British live-stock industry is a very varied one, involving a number of interests, and anyone starting farming will have to consider very closely the local conditions before deciding which branch it will pay him best to follow. In purchasing and selecting stock in the market for any particular purpose the farmer and dealer generally make their

CALF-REARING

Most of the foregoing points would also equally apply in the case of the selection of a dairy cow, especially one required for dual purposes. The head, however, might be somewhat longer and tapering towards the muzzle; the width of the chest also is not so essential, although it should be of sufficient capacity to prevent any tendency to lung disease. The barrel and belly should be capacious, so as to allow of a large and well-formed digestive system which is essential for the assimilation of nutrition. The hind quarters are most important, and a good length from hook bone to pin bone is particularly necessary to give the length in quarter required for supporting a capacious udder. When viewed from behind, the legs should be well apart, leaving plenty of room for a good udder between, and the cow should have a general broad appearance from this aspect.

The udder should be square and neatly formed; not necessarily very large, but well set on behind and coming well forward, with four good-sized teats nicely placed so as to allow plenty of room for milking purposes. It should not be too pendulous or pointed, should be free from fleshiness, and the skin when handled should be soft to the touch and covered with a network of fine veins. The hair should be silky and not excessive in quantity. A well-developed milk vein—that is, the large veins on the under side of the abdomen which convey the blood back from the udder—is generally looked upon as a good indication of powers of milk production.

A good type of dairy cow should, therefore, be recognised by a soft skin, clear and mild eyes, a somewhat narrow and elongated head, and an udder of large size, but well placed and of sufficient muscular strength to prevent it from being baggy or pendent. The milk veins coming from each side of the udder should also be well-developed.

BREEDING. In the ordinary management of domesticated cattle the milking period begins with calving, after which the yield of milk rises slightly for a few weeks, and then falls off gradually till the cow is dry. In nature spring is the time of the year for young animals to be born, when there is every prospect of an ample supply of food for mother and offspring during the coming growing period. This is still followed in a good many districts, especially on cheese-making farms where a large flow of milk is required for the summer, and also in the case of many of the beef breeds. On milk-selling farms, however, where a supply of milk has to be maintained all the year round, arrangements have to be made for this purpose, and it is found necessary to calve a number of cows in the late summer and early autumn to provide for the winter dairy.

We must remember that the power of production of milk has been greatly extended under domestication, and that a cow gives a larger yield, and for a longer period, than she would in the wild state. Moreover, in ordinary circumstances she will soon be in calf again, so that, during the greater part of her milking period, not only has she to provide for a large flow of milk produced under artificial conditions, but also to repair the ordinary wear and tear of her system, besides nourishing her special condition. If a cow is subjected to bad treatment and poorly fed, not only will her own constitution be undermined, but the future life of the calf will be seriously affected. It is, therefore, essential that care and intelligence should

play an important part in the breeding and management of dairy stock on rational lines. These remarks, of course, do not apply to beef breeds reared under more natural conditions.

CALF-REARING. Nature's method is for the calf to suck the cow, and this is best as far as the latter is concerned, being followed with some of the poorer milking breeds, as Herefords, Galloways, and Highlanders. Pedigree calves, especially bulls, in other breeds are also frequently allowed to run with their dams. Again, where calf-rearing is the principal object, a cow with a good flow may be made to rear two calves at the same time, and when these have been weaned a second pair may be put to the cow.

On most farms, however, milk is too valuable an article for feeding calves, and they have to be reared on some artificial substitute in the form of calf meal. The usual method is to allow the calf to suck its mother for the first few days, when the milk is of special composition—known as colostrum—and of no use for commercial purposes. The calf is then removed, receiving new milk for a day or two, and this is gradually changed into a diet consisting of separated milk made up to the standard of whole milk by the addition of some substitute.

When the calf is taken away from its mother it should be fed from a bucket, preferably, three times a day with new milk, the allowance gradually rising to about two quarts at each meal. At the end of a week or so a gruel made with calf meal should be worked in by degrees, thus reducing the quantity of milk. Separated, or skim, milk, which contains considerable feeding value, should, if available, gradually take the place of the new milk, and be used for mixing with the gruel. On milk-selling and cheese-making farms, where there is no separated milk, whey or water has to be used instead in making the gruel.

At the end of a month the calf will be on a diet of warm gruel, given in three feeds daily, consisting of



A LONGHORN HEIFER

Photo, Vinton

one to three pounds of calf meal, according to its strength and whether separated milk is available or not.

About this time a little sweet hay may be put in the rack for the calf to nibble at, and dry food, with a little linseed cake, may be gradually substituted while the gruel is reduced, the midday meal being stopped first. When about six weeks old calves may be turned out to grass in summer during the day,

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and will soon learn to graze; but it is advisable to give them shelter at night. Weaning should take place when the calves are about five months old, the gruel being then finally stopped.

In some parts of England, especially in the north, the calf is removed immediately it is dropped and before the cow has time to lick it. It is then fed for the first week on its mother's milk, given warm, and for the next few days on new milk, not necessarily its mother's. The subsequent treatment is similar to that recommended in the former case. It seems questionable, however, whether this method is as good for the cow as the more natural one of allowing the calf to suck its dam for the first few days.

SUBSTITUTES IN CALF-REARING. Substitutes in calf-rearing may be divided into: (1) Cream equivalents, to take the place of the fat removed from separated or skimmed milk; and (2) milk substitutes, or calf meals, to take the place of whole milk when made into a gruel.

The following substitutes for fat may be used with good results, namely, cod liver oil, pure linseed, and pure linseed cake. The first of these may be fed at the rate of two ounces per calf per day, being stirred into the separated milk, but it must be remembered that great harm may be done by a careless use of the oil.

There are many excellent patent calf meals and cream equivalents now on the market at a reasonable price, and in the majority of cases it will pay to use these, unless a large number of calves are being reared.

A safe home-made calf meal can be made as follows: Oatmeal, 2 parts; linseed-cake meal, 2 parts; pure crushed linseed, 1 part. A small quantity of ordinary flour or arrowroot may be added to counteract any tendency against scouring.

REARING AFTER WEANING. Calves, after weaning, must be kept under cover the first winter, and the run of a good covered yard will be found most useful for this purpose. They must not be allowed to lose their flesh, and should receive a liberal ration, consisting of a few roots, sweet hay, and a mixture of about $1\frac{1}{2}$ to 2 pounds of linseed cake and meal each day.

At the end of the winter yearling steers and heifers may be turned out on to good grass, and they will then graze, with no extra food, during the summer, and should come in in good condition towards the autumn. During the second winter they should receive roots, hay, and straw, together with an allowance of cake and meal. For those intended for *early beef* the ration should be gradually increased until they are ready for the butcher at twenty to twenty-four months old.

The yearlings which are run through the second winter as stores may be turned out to grass in the following summer, and then taken up towards the autumn and fed for winter beef when from two to three years old. Bullocks run on as stores till three years old may be grazed fat on feeding pastures during the fourth summer. Heifers intended for breeding should be only kept in store condition and put to the bull when they are about two years old, so that they will calve down before the end of the third year.

One of the principal mistakes in modern stock

breeding is allowing the young animals to lose all their condition during the first, and especially during the second, winter, and there is then immense loss in food and time in making up this wastage before the animal is fit for the butcher. A secret of success in modern farming is never to allow the calf flesh to be lost, and to keep the young animal steadily going on till it is ready for the block. In the case of heifers, allowing them to get into too poor a condition is sure to act detrimentally on their first calf, to say nothing of the value of the heifer herself if intended

for the market; and here, again, trying to save a few shillings during the rearing period will be found a penny wise and a pound foolish policy.

DETERMINATION OF AGE.

The age of cattle can be told by the appearance of the horns and teeth. Advantage is taken of the changes in the incisor teeth in the lower jaw for this purpose, the permanent teeth as produced being much broader in appearance than the milk teeth they replace. Thus, just before the ox is two years old the two central permanent incisors make their appearance;

at about two and a half years old the next pair, or the "middles," come through; at three years the "laterals" appear, and at three and a half years off the "corner" incisors are through. These indications will be useful when there is any doubt as to the age of an animal. It must be remembered, however, that in well-bred cattle the development of the teeth is earlier than in inferior animals. Again, as the age increases the teeth become worn, and continue to shorten, and apparently to separate from each other; this fact will act as a further guide.

As regards the horns, a small but distinct ring is formed at the base at three years old, when a heifer generally produces her first calf. A similar ring is then formed each succeeding year until the animal is ten years old, when the circles get rather confused. Unscrupulous dealers will sometimes obliterate the marks on the horns, but taking the number of nicks on the horns and the appearance of the teeth together, there should be little difficulty in determining the age of an animal.

FEEDING FOR BEEF. Before the advent of the turnip and its present method of intensive cultivation in rows, cattle were wholly dependent on the hay and straw grown on the farm for their sustenance during the winter, and consequently feeding with a view to fattening at this time of the year was impossible.

With the introduction of the turnip, swede, and mangel as winter foods, matters were considerably improved, and when linseed-cake was added winter feeding on modern lines came into practice. But the great advance was made towards the end of the nineteenth century, when the fall in the price of grain, and the increased facilities of transport caused the introduction of a number of concentrated feeding stuffs before unknown. Thus, cotton-cake and maize were added to the common feeding stuffs of the farm, and these were shortly supplemented with bye-products of certain industries, such as brewing and milling. In this way the nutritive value and palatability of winter rations were greatly increased, and the time required to prepare a store beast for the butcher was much reduced.



AN AYRSHIRE COW

Photo, Vinton

MANAGEMENT OF THE COW

With the introduction and common use of new foods during the nineteenth century, an improvement was also effected in the cattle that were to consume them, especially as regards early maturity, so that animals are now fattened off for the butcher at a much earlier age than formerly.

There are two main systems of feeding for the production of beef in Great Britain: (1) Grazing cattle on first-class pasture land during summer; and (2) feeding cattle in yards or tied up in sheds during winter.

In former days bullocks, after they had worked a season or two in the plough, and cows when they had put their best into the pail, were fed off on grass during the growing season, and the beef supply was consequently of somewhat a mature character. Now, however, everything has changed. The public demand small, succulent joints with plenty of lean meat, and the farmer and grazier have had to alter their methods accordingly. Bullocks and heifers are consequently fed off at two to three years old, and every means is taken to hasten them on their way to the block.

On the best English grazing lands, as in Northamptonshire and Leicestershire, strong stores—unless bred on the farm—are bought in the spring markets at about three years old, and at once turned out to graze. Towards the end of the summer these beasts should be ripe and ready to go off, having increased some two hundredweight or more in live weight. In a good grass year on first-class feeding land it is even possible to put on a second lot towards autumn, and to finish these off with cake before winter.

The methods of feeding cattle in yards, boxes, and sheds during the winter are principally followed in the eastern parts of England and Scotland where large arable farms exist, and where it is necessary to manufacture quantities of yard manure for use on the ploughed land. In these cases turnips, swedes, mangels, straw, and hay grown on the farm form the bulky food, and purchased cake and meal are added to supplement the rations and increase their nutritive and digestive qualities. The amount of concentrated food used is, as a rule, from 4 to 10 pounds per bullock per day, starting with the smaller amount and gradually increasing the quantity as the animal ripens.

There is more in the art of feeding than people imagine, and two men may obtain very different results with the same quantity and description of food given to similar animals. The necessity for regularity in the hours of feeding cannot be too strongly insisted on, and the judgment of the stockman in studying and tempting the animal's appetite, and seeing that everything is cleared up before the next meal is a great factor. Any unnecessary disturbance should be avoided, and the cleaning out of the stalls should be done as far as possible when the animals have some food in their troughs to occupy their attention.

The question of the preparation of the food with a view to making it more palatable and digestible is also another consideration. No doubt pulping the

roots, chaffing the fodder, mixing and leaving the mass to ferment for some hours before feeding is economical where a large number of cattle are being fed, as rough fodder can often be used for this purpose which would not be palatable by itself. It also makes the food more digestible, especially in the case of young animals. Where small quantities of cattle are being dealt with, and the labour of pulping and chopping has to be done by hand, it is doubtful whether the system pays.

COWS AND THEIR MANAGEMENT

DAIRYING. The chief objects of a cow's life are (1) to give a large yield of milk, and (2) to produce a calf yearly. Heifers do not give their full quantity of milk with the first calf, but the yield improves with each subsequent calf up to the fourth or fifth, after which the milk generally deteriorates in quantity and quality. In a natural state the amount of milk produced would be only sufficient for providing for the wants of the calf, but under domestication, as already pointed out, the milking properties of cows have been greatly developed. If an average were taken of the ordinary farm herds of dairy cows throughout the United Kingdom, it is probable that the yield would not represent much more than 550 gallons per cow per annum.

Good farm herds of shorthorn, or Ayrshire cows, where a record is kept and selection is practised, should average at least 650 gallons per cow per annum; although many individual animals will give considerably more than this. An ideal for the dairy farmer to aim at possessing is a 1,000-gallon cow, but they are not to be obtained readily, although under the present more careful system of selection they are more common than they were formerly. The average annual yield of ordinary milkers of the principal dairy breeds may be taken, in gallons, as follows: Shorthorn 600; South Devon, 550; Red Poll, 500; Ayrshire, 550; Kerry, 450; Jersey, 500; Guernsey, 550.

It is commonly estimated that three acres of grass land are necessary to keep a cow for the year, providing pasturage during the summer and hay for winter feeding. As a matter of fact, with good grass land rather less would suffice, and this is also the case with farms which are partly arable, and where crops are specially cultivated for use in the dairy. Thus, where there is a certain amount of arable land connected with the holding, a greater number of cows can be kept on the same area, especially during the winter.

During summer cows are kept on pasture, which is excellent for inducing a flow of milk, and consequently at this time of the year milk can be produced at a cheaper rate than at any other season. The price of milk is, therefore, lowered in milk contracts during the summer months, and the farmer, who has no difficulty in getting rid of his winter milk, very often finds himself saddled with a large surplus supply during the growing season which he can only dispose of at a miserably low figure. It seems a pity that farmers in grass districts where they are subject to a summer glut of milk do not combine to start cheese factories which would take all the surplus supply, and thus prevent the



A WELSH BULL

Photo, Vinton

HARMSWORTH NATURAL HISTORY

price of fresh milk at this season from dropping to an unremunerative price for the producer.

Towards autumn, when the grass is less nutritious, and tends to go off in quality, it is a good practice to allow a small quantity of undecorticated cotton cake, say, 2 to 4 pounds per head per day, which, besides adding to the feeding value of the ration, tends to check any undue laxative effects of the grass on the cows at that season.

The management and feeding of cows in winter



A JERSEY COW

Photo, Vinton

vary very much with climate and district. In the south of England, where the climate is mild, the cattle are out during the best part of the day, being brought into yards and open sheds for the night and for purposes of milking. In the north of England, on the other hand, where the weather is often inclement, dairy stock are kept entirely indoors during the best part of the winter, only being allowed out for a short time each morning to get watered. It must be remembered, however, that in those districts in which the housing system is strictly adhered to there is all the more chance of tuberculosis being developed, owing, in many cases, to the lack of proper ventilation and sanitary precautions.

Cows need a diet somewhat relaxing to the bowels, so that in winter they require roots and meadow hay, together with small quantities of linseed or treacle, to be used along with the coarser forage. Swedes, turnips, kale, cabbage, kohlrabi, mangels, carrots, and parsnips may all be used with safety during the winter for the production of milk. In addition to these, it will be necessary to use a mixture of concentrated foods, not exceeding 10 to 12 pounds per day, to strengthen the ration where cows are producing milk during the winter. Both sorts of cotton-cake, soya-bean cake, dried brewers' grains, bran, oats, and maize are all good foods for this purpose.

It is very necessary for purposes of economy that some relation should exist between the amount of artificial food given and the milk yielded, and it ought to be the duty of the cowman to see that those cows which are putting their best into the pail should receive the full quantity of cake and meal, while those which are falling off should have their concentrated food reduced.

Experience and the result of numerous tests seem to point to the fact that the food affects the quantity of the milk rather than the percentage of solids it contains; and that the quality of the milk is determined rather by the natural capacity or constitution of the cow than by the amount of food it eats. Thus,

some cows yield milk naturally rich in butter fat, while others are exactly the reverse in this direction. This is a distinctly interesting point to note when we take into account the present legal standard of 3 per cent. of butter fat.

The two principal products manufactured from milk are butter and cheese. Butter is really the fat which has been withdrawn from the body of the milk by the processes of separating and churning. The old-fashioned method of shallow pan-setting, which occupied a large amount of space and time, is now completely out of date, and the cream separator is used instead to divide the cream from the milk immediately the latter is brought into the dairy. The cream is afterwards "soured" or "ripened" in glazed crocks or cans before being churned into butter, as it has been found that the butter made from sour cream is of better flavour, yields better, and keeps longer than that from sweet cream.

The fermentation or souring of milk and cream being a natural process brought about by minute species of bacteria which obtain access to it through the air, it is essential that in the operation of milking in the shed and in handling the milk and cream afterwards in the dairy scrupulous cleanliness should be observed. If this is not attended to other species of bacteria which flourish under dirty conditions will at the same time enter the milk and cream and give rise to bad taints and flavours, which are disastrous to successful dairying.

It will be found that two and a half to three gallons of ordinary milk will be required to make one pound of butter. Channel Islands cattle milk, which is generally very rich, will often yield one pound of butter to two gallons of milk.

The manufacture of cheese is a most important dairy industry in some districts, as Cheshire, Gloucestershire and Somersetshire. The principal varieties of cheese manufactured in England may be divided into (1) pressed or hard cheeses, including Cheddar, Cheshire, single and double Gloucester; and (2) unpressed



A GUERNSEY COW

Photo, Vinton

cheeses, including Stilton, Wensleydale, Caerphilly, and the numerous varieties of soft and fancy cheeses.

STATISTICS OF CATTLE IN THE UNITED KINGDOM.

Of the enormous capital invested in the live stock industry in the United Kingdom no less a sum than £120,000,000 must be put aside to represent the current value of the stock of cattle. From the figures furnished by the Statistical Department of the Board of Agriculture, in 1907, it is shown that the total stock of

DOMESTICATED CATTLE

cattle in the United Kingdom cannot be computed at less than 11,700,000 head, showing an increase of over 30 per cent since 1867. These figures compared with the measured surface of the United Kingdom would place the number of cattle at 150 head per 1,000 acres against 112 head per 1,000 acres in 1867.

As regards the future of the cattle industry in the United Kingdom, it should always be the aim of British breeders to maintain the reputation they have gained by keeping to a high standard and producing the best stock possible. There is also little doubt that the present class of stock required for the home markets is a dual-purpose animal, capable of producing both milk and flesh, and this type has been successfully developed by some of the best breeders.

We readily see the importance of the milk trade when we recollect the production in the United Kingdom is some 1,720,000,000 gallons annually, which is all consumed in the community, either directly or in various manufactured forms. When we further take into consideration that one gallon of milk is worth in value one pound of beef, and that three to four gallons of milk can be produced at the same cost as one pound of beef, there seems every inducement for the extension of the dairy industry. One other point may be mentioned with a view to the development of the milking properties of cattle, that is, the keeping by all dairy-men of milk records, showing the performance of each animal in their herds. There is little extra trouble or labour attached when the system is properly carried out, and it is the only method of ascertaining what each animal is actually doing, and whether it is paying its way, and should be bred from again, or whether it should be drafted to the butcher. In this way, the best milking and most profitable cows are recognised, and their heifer calves can be kept for taking their places in due course in the herd



A DUTCH BULL

When we consider the enormous value of the cattle industry in this country, it is easy to understand that any slight improvement that can be made by the efforts of breeders in the milk-yielding or beef-producing powers of their stock would, taken in the aggregate, represent a large increase to the national revenues.

DRYSDALE TURNER

FOREIGN DOMESTICATED CATTLE

Of the numerous Continental breeds of cattle only a few need be mentioned. One of the most esteemed is the Friburg breed, which seems to be allied to the shorthorns, but has a longer body and neck. The horns are short but sharp, and the colour is a mixture of black or reddish brown with white. These cattle are largely bred in Switzerland, and



A KERRY COW

Photo, Vinton

are considered to be the parent stock from which several other breeds have originated.

The Dutch breed was originally a native of the lowlands of Holland, but is now spread over a large part of Germany. Dr. Fitzinger regarded Dutch cattle as the direct descendants of the aurochs, and this view is confirmed by the frequent presence of a white line along the back. These cattle are of large size, with long necks, pointed muzzles, and moderate-sized horns directed forwards and inwards. The usual colour is black upon a white or greyish white ground, but the dark markings may be brown or reddish.

The celebrated black fighting Spanish bulls of the Castilian breed are nearly allied to the Channel Islands cattle, and noticeable for retaining the pale dorsal streak of the aurochs; their horns being likewise of the aurochs type. On the other hand, the large-horned, fawn-coloured draught cattle of Spain are of a different type, which, it has been suggested, may have a mixture of the blood of humped cattle.

Very different from any of the above are the cattle of the Roman Campagna, which are a large, straight-profiled, silver-grey breed, marked by a white dorsal stripe, and generally with a white ring round the eye. To the north and south they are replaced by the ordinary white Italian cattle, which are themselves believed to be related to the grey Alpine cattle. With regard to the origin of the Campagna cattle it is generally admitted that they are related to the long-horned, pale-coloured breeds of Hungary and Podolia, and it has been suggested that they are descended from herds of that stock introduced into Italy by the Longobards, the main ground for this opinion being the general absence of effigies of the former breed from the ancient Roman sculptures.

As regards the aforesaid Hungarian and Podolian cattle, of which there are two breeds, the bulls are

characterised by the drab colour of the coat being relieved by black rings round the eyes, and by black markings on the muzzle, dewlap, and certain other parts of the head and body. The oxen and cows, on the other hand, are self-coloured. The horns may measure as much as 5 feet from tip to tip, and are black at the extremities, but greyish throughout the rest of their length. These breeds range through Hungary into Turkey and Western Asia, but, on account of their poor flesh-forming qualities, are being rapidly displaced by other races.

In Northern India many of the breeds of domesticated cattle appear to be the results of crossing between European cattle and humped cattle, showing the general shape of the former, but the white rings on the fetlocks characteristic of the latter. In Africa there are several kinds of humpless cattle, among which the Namaqualand breed most nearly resembles ordinary European cattle. The Ankoli cattle of Uganda, which likewise appear to be a humpless breed, are also characterised by the great length of their horns, which are largest in the cows, those of the bulls being shorter and thicker. As a rule, the bulls are white and the cows brownish red.

In certain parts of America, the Falkland Islands, Australia, New Zealand, and other countries cattle introduced from Europe have run wild and formed vast herds. Those found in Texas and on the Argentine pampas have become of a nearly uniform dark brownish red colour, while in the Ladrone or Marianne Islands, in the Pacific Ocean, all the wild cattle are white, with black ears, like some of the British park breeds. When Lord Anson visited the Ladrone in 1742, the number of these cattle was estimated at upwards of ten thousand. In the Falkland Islands it was stated by Admiral Sullivan that those in the southern districts were white, with the feet, ears, or the entire head black, but in other parts they were either brown or mouse-coloured. The wild cattle of New Zealand are white spotted with brown. In Australia the herds are of great extent, and are difficult to approach within shooting distance on account of the wariness of the animals.

In Argentina the cattle are very wild, but take little notice of a mounted man; if, however, as is seldom the case in a country where everybody rides, they are approached by a person on foot, they gallop round in circles, with threatening gestures, looking every moment as if about to make a charge, although it does not appear that they ever do so. In Colombia wild cattle are found not only on the plains, but high up in the Cordilleras, and herds of considerable size have been met with in the highlands of Central Asia.

Here may be mentioned the snub-nosed cattle of Argentina, known as *niatus* or *natus*. This breed, which has existed for more than a century, bears the same relation to other races as is presented by pugs to ordinary dogs. According to Darwin, "the

forehead is very short and broad, with the nasal end of the skull, together with the whole plane of the upper molar teeth, curved upwards. The lower jaw projects beyond the upper, and has a corresponding upward curvature. The upper lip is much drawn back, the nostrils are seated high up and are widely open, the eyes project outwards, and the horns are large. The neck is short, and in walking the head is carried low. The hind legs appear to be longer, compared with the front legs, than is usual. The exposed incisor teeth, the short head, and upturned nostrils give these cattle the most ludicrous, self-confident air of defiance."

Niatus appear to be very rare, but I had the good fortune to see a pair in the grounds of the museum at La Plata in 1893. These were black and white in colour; the characteristic features of the breed being much more strongly displayed in the bull than in the cow.

HUMPED CATTLE

The common domesticated cattle of India and many parts of Africa are distinguished from those of Europe, not only by the presence of the hump on the withers, but by other structural features, as well as by their general colour, voice, and habits (page 574). Hence, although they are known only in the domesticated state, there can be no hesitation in regarding them as constituting a species distinct from European cattle. In Europe these animals are generally called zebu (*Bos indicus*), although it does not appear that any such name is known in India.

In addition to the enormous hump on the withers, humped cattle are characterised by a certain degree of convexity of the forehead, by the upper border of the short horns being uniformly concave, by their large drooping ears, and the enormous dewlap which hangs in folds along the whole length of the neck. In size and colour these cattle are subject to a

considerable amount of variation, but they are very generally characterised by a distinct white ring round the fetlocks. While the largest individuals stand as high as a buffalo, the smallest are little taller than a calf of a month old. The most common colour is a light ashy grey, which may shade off into cream colour, or even milk white; but various tints of red or brown are often met with, and occasionally black individuals are seen.

In disposition these cattle are always gentle, and the larger breeds are employed in India for drawing native carriages. The voice is more of a grunt than a low; and these cattle differ from European cattle in habits, in that they seldom seek the shade, and never stand knee-deep in water. In many districts of India a certain number of privileged bulls are specially protected by the Hindus. In a few districts Indian humped cattle have run wild; those found on the sea coast near Nellore, in the Carnatic, have been in this state for a long period, and are described as extremely shy and wild, their size being large and their horns long. Humped cattle are probably descended from the bantin of the Malay countries (p. 645).



A HUNGARIAN COW

HUMPED CATTLE

Among the various Indian breeds, the Hissar cattle of the North-West Provinces are of a very large size, with drooping ears, and the horns black and curving outwards, backwards, and downwards, the bulls being generally pale grey, like many of the cows. In the other breeds the ears do not droop, and the bulls are frequently black. Of these, the Gujerat cattle are smaller than the Hissar breed, and have the horns, which are thick at the base, directed upwards, outwards, and forwards. The hump is very large in the bulls. In the Mysore breed the horns have also an upright direction, but do not curve forwards, and, in old bulls, have a double twist, being directed at first outwards, then forwards, and finally outwards or backwards. The Gaini, or dwarf, breed is sufficiently characterised by its diminutive size, adult bulls often little exceeding 3 feet at the shoulder.

Humped cattle are also found in China, Africa, and Madagascar; and it has been suggested that the group might have had an African origin. In North-Eastern Africa humped cattle are represented by the Galla ox, or sunga (*Bos indicus africanus*), characterised by the enormous size and thickness of the horns, which are lyrate and doubly curved, somewhat after the fashion of those of the Mysore breed, only much more massive. In this breed the forehead of the skull lacks the convexity characteristic of Indian humped cattle.

Nearly allied to the Galla breed are the great Nuer cattle of the Egyptian Sudan, which are either uniformly coloured or variegated with white, with the massive horns bending forwards. In the Blue Nile breed, which is generally whole-coloured, the horns are directed mainly forwards and upwards, and are of a more slender type.

The Moshi and Hausa humped cattle

In concluding this account of the typical group of cattle, it may be mentioned that several species occur fossil in India, among these being the magnificent Narbada ox (*B. namadicus*), of the gravels of the valley of the Narbada, which was fully equal in size to the aurochs, and in the typical form had horns with a cylindrical section. It is, however, noteworthy that in one race of this species the horns were somewhat



MYSORE COW



HISSAR COW



GAINI BULL

of Western Africa, on the other hand, are usually parti-coloured, and often spotted. Enormously long horns are carried by the Damara breed, distinguished by its small hoofs, slender limbs, and the large size of the tail tuft. In the case of the Bechuanaland cattle Darwin recorded a pair of horns measuring 13 feet 5 inches along the curve from tip to tip, and 8 feet 8 inches in a straight line.

flattened, and thus approximate to those of the living wild cattle of India. In the somewhat older deposits of the Siwalik Hills occur remains of the gigantic sharp-fronted ox (*B. acutifrons*), distinguished by the sharp ridge running down the middle of the forehead and the enormous length of the horns, which swept upwards and outwards in a bold curve, and were probably but little short of 10 feet in span.

THE GAUR

With the magnificent animal known as the gaur (*Bos gaurus*), but generally misnamed by Indian sportsmen the bison, we come to the first of a group of cattle confined to South-Eastern Asia, and collectively characterised by the following features: The horns are flattened to a greater or less degree from front to back, more especially at their bases, where they present an elliptical cross-section, this character being more strongly marked in the bulls than in the cows. The tail is shorter than in typical cattle, and reaches little if at all below the hocks. A third feature is presented by the distinct ridge running from the shoulders to the middle of the back, where it ends in an abrupt drop, which may be as much as 5 inches in depth. This ridge is caused by the great height of the spines of the vertebrae of the fore part of the trunk as compared with those of the loins; but it is a character much less developed in the bantian than in the other species. The members of this group also present a distinctive type of colouring, the bulls being frequently dark olive or nearly black, the cows and young bulls either somewhat paler or reddish brown, while in both sexes the legs from above the knees and hocks to the hoofs are white or whitish. The hair is short, fine, and glossy, and the hoofs are narrow and pointed.

for me. There were fourteen of them. I had the greatest difficulty in avoiding their blind galloping onslaught, and only just had time to plant myself behind a stout mhowa tree as they passed to right and left.

On they went crashing through bamboo clumps, treating them as if they were but grass. Far down the valley dust and splinters of bamboo in the air marked their headlong flight. Most people would have supposed that the herd would travel a long way. I waited until my friend came up. He informed me there was a larger male gaur than the one he had killed in the herd.

can track it on soft soil. The largest gaurs' heads I have ever seen were those of animals killed by Colonel Blest and H. W. Wendon, Esq., late chief engineer to the Great Indian Peninsular Railway. The horns measured 22 inches round the base. One was killed at Heeraghr in the Asseerghur jungles; the other at Puchmurree. I killed one also near Heeraghr, which measured 21 inches round the base of horns. I often wished for a camera in the jungle, but you can't shoot and photograph at the same time. It is living beasts I should have liked to photograph, not the dying or the dead.

F. G. ALEXANDER

THE GAYAL

The handsome animal known as the gayal, or mithan, was originally described as a distinct species, under the name of *Bos frontalis*, but there is little doubt that it is a domesticated breed of the gaur, nearly allied to the Malay race of the latter. If, however, it is, or has been, really wild, it is entitled to the designation *B. gaurus frontalis*.

Compared with the typical Indian gaur, the gayal is a somewhat smaller animal, with proportionately shorter limbs, a minor development of the ridge on the back, and a more distinct dewlap on the throat of the bulls. The head is also shorter and broader, with a perfectly flat forehead and a straight line between the bases of the horns. The horns, which are very thick and massive, are less flattened and much less curved than in the Indian gaur, extending almost directly outwards from the sides of the head, and

curving somewhat upwards at the tips, but without any inward inclination. Their extremities are thus much farther apart than in the Indian gaur; but, as mentioned above, the Malay representative of the latter comes very near in all these respects to the gayal.

The colour is very nearly the same as in the latter, the head and body being blackish brown in both sexes, and the lower portion of the limbs white or yellowish. The horns are of uniform blackish tint from base to tip. Some gayals are parti-coloured, while others are completely white. The gayal stands much lower at the withers than the gaur, cows being much smaller than bulls, with scarcely any dewlap on the throat.

In a more or less domesticated condition large herds of gayal are kept by the Kuki tribes in the hill districts of Tippera; and some of the domesticated cattle kept by the hill tribes on both sides of the Assam valley, in the districts of Manipur, Cachar, Chittagong, and the Lushai Hills, are also gayal, although others are gaur. Very probably these tame gayal occasionally interbreed with gaur. The herds of gayal are kept for food, and, according to some authorities, for milk, although this is doubtful, since most of the Indo-Chinese tribes who keep mithans never drink milk. The animals, which appear to be never employed in agricultural labour or as beasts of burden, roam and feed unattended through the forest during the day, and return to their owners' village at night.



A BULL GAYAL

We sat down and held a council of war, and then I took up the tracks of the gallopers. Two miles off I found the beasts grazing peacefully, as if nothing had happened. Tracking in such circumstances is easy work, with debris to guide you all the way. I have usually found that gaur, when alarmed by a rifle shot or other cause, do not gallop for over three miles, but it is just as well to wait a little before you follow, as they are for some time very vigilant.

Many times calf gaur have fallen into my shikarees' hands, especially when cattle disease has been rife. Every effort has been made to rear them, but in vain. They have often lived for over three weeks and been nourished by domestic cattle; eventually, however, the calves died. The Bheels have a queer notion that artificial light, such as an oil-lamp, kills the calves, but I think that want of strong nutrition is the cause. They require such milk as no domestic beast can give them.

During the hot weather one rarely finds gaur on the plain. I have, however, killed a few bulls which have descended to the plain in order to reach another range of hills—in fact, they were taking a short cut from place to place. Where I killed most of my gaur was on plateaux rising from 2,000 to 3,000 feet above the sea. In the monsoon I have frequently found gaur on the plain, whither they had gone to escape from leeches or irritating flies. The gaur is far easier to find in the monsoon, owing to the rapidity with which one

THE YAK

Like gaur, gayal are essentially inhabitants of hill forests, and the facility with which they traverse rocky country is little short of marvellous for animals of such bulky proportions.

THE BANTIN

The bantin, or Javan ox, (*Bos sondaicus*) differs considerably from the gaur, which it serves in some degree to connect with typical oxen. The most distinctive feature of this species is the large white patch on the hind quarters, which extends upwards to the root of the tail, although not surrounding it. Another peculiarity of the typical bantin is that the cow has the head, body, and upper portions of the limbs of the same reddish brown, almost chestnut, colour as the calves.

The general build of the animal is slighter than that of the gaur, the ridge on the back is much less developed, and the legs are proportionately longer. The head is also more elongated and pointed; while the horns, which are cylindrical in the young, are relatively smaller. In the adult bull they are flattened at the base, and are much curved, the direction being at first outwards and upwards, although towards the tips they incline inwards and somewhat backwards; between their bases the forehead is covered with hard and somewhat horny warty skin. The tail descends below the hocks, and the dewlap is of moderate size.

In the typical Javan bantin the old bulls are black, with the exception of the white patch on the buttocks and the legs from the knees and hocks downwards. The young calves, like those of the gayal, have the whole length of the outer surface of the limbs chestnut, and they are also distinguished by a dark streak down the back. A full-grown bull bantin from Java measured 5 feet 9½ inches at the withers. In the Burmese race, or tsaine (*B. sondaicus birmanicus*), both sexes are usually a tawny chestnut throughout life, although they tend to become darker when adult and a few old bulls are stated to turn almost black. In some instances bull tsaine from Siam have the whole coat marked with small white flecks.

The bantin is confined to the regions lying to the east of the Bay of Bengal, occurring throughout Burma, and probably extending as far north as the hills eastwards of Chittagong, while it also inhabits the Malay Peninsula, the islands of Java, Bali, Borneo, and probably Sumatra, and also Siam. Large herds of domesticated bantin are kept by the Malays in Java, and also in the small island of Bali, lying to the south-east, which are replenished by importation from Java. These tame Bali bantin, in which the white area on the rump is reduced to a small patch on the hind surface of the buttocks, afford at least a considerable portion of the supply of beef to Singapore.

Red or tawny is probably the ancestral colour of the ox tribe, and the fact that both sexes of the Burmese and the cows of the Javan race permanently retain this original colouring, which is transient in the gaur, indicates that the present species is less specialised than the other, the dark colour being acquired only in the male of the typical race. This is confirmed by the structure of the bantin, which departs less widely from that of the typical oxen than is the case in the gaur.

Although the accounts of the habits of the bantin are not very full, it appears that in these respects this animal is very similar to the gaur. It has been suggested, however, that from its relatively longer legs the bantin is less addicted to climbing rocky hills than the gaur, and that it is accordingly more restricted to the plains; but this does not seem to be borne out by the accounts of sportsmen.

The extinct Etruscan ox (*B. etruscus*), from the Pliocene of the Continent, appears to have been allied to the bantin, but the horns of the bulls are placed low down on the skull near the eyes, and the cows are hornless.

THE YAK

The yak (*Bos grunniens*), which is one of many species of mammals peculiar to the elevated plateau of Tibet and the adjacent districts of China, differs markedly from all other members of the ox tribe, although to a certain extent it forms a connecting link between the preceding group and the bison. The most distinctive peculiarity of the yak, so far as external features are concerned, is the mass of long hair with which the flanks, under parts, limbs, and tail are clothed, and which makes the appearance of the animal very different from that of other cattle (page 524).

On the head and upper parts of the body the hair is short and nearly smooth, and the long hair only begins on the lower part of the sides, where it forms a fringe of great depth, extending forwards across the shoulders and backwards on to the thighs. On the tail the long hair is developed on the lower half, where it expands into an enormous tuft, which does not generally reach below the hocks. There is also a tuft of long hair on the breast. The colour of the hair in the wild yak is uniform dark blackish brown, sometimes tending to a rusty tint on the flanks and back, and with a grey grizzle on the upper part of the head and neck in very



A DOMESTICATED YAK

old individuals, and around the muzzle a little white. Many domesticated yak, especially those living at elevations much below that of the Tibetan plateau, are, however, black or brown and white, or even pure white.

In build the yak is massively formed, with short and stout legs. The shoulders are high, but there is not the distinct ridge on the back characteristic

for me. There were fourteen of them. I had the greatest difficulty in avoiding their blind galloping onslaught, and only just had time to plant myself behind a stout mhowa tree as they passed to right and left.

On they went crashing through bamboo clumps, treating them as if they were but grass. Far down the valley dust and splinters of bamboo in the air marked their headlong flight. Most people would have supposed that the herd would travel a long way. I waited until my friend came up. He informed me there was a larger male gaur than the one he had killed in the herd.

can track it on soft soil. The largest gaurs' heads I have ever seen were those of animals killed by Colonel Blest and H. W. Wendon, Esq., late chief engineer to the Great Indian Peninsular Railway. The horns measured 22 inches round the base. One was killed at Heeraghr in the Asseerghur jungles; the other at Puchmuree. I killed one also near Heeraghr, which measured 21 inches round the base of horns. I often wished for a camera in the jungle, but you can't shoot and photograph at the same time. It is living beasts I should have liked to photograph, not the dying or the dead.

F. G. ALEXANDER

THE GAYAL

The handsome animal known as the gayal, or mithan, was originally described as a distinct species, under the name of *Bos frontalis*, but there is little doubt that it is a domesticated breed of the gaur, nearly allied to the Malay race of the latter. If, however, it is, or has been, really wild, it is entitled to the designation *B. gaurus frontalis*.

Compared with the typical Indian gaur, the gayal is a somewhat smaller animal, with proportionately shorter limbs, a minor development of the ridge on the back, and a more distinct dewlap on the throat of the bulls. The head is also shorter and broader, with a perfectly flat forehead and a straight line between the bases of the horns. The horns, which are very thick and massive, are less flattened and much less curved than in the Indian gaur, extending almost directly outwards from the sides of the head, and

curving somewhat upwards at the tips, but without any inward inclination. Their extremities are thus much farther apart than in the Indian gaur; but, as mentioned above, the Malay representative of the latter comes very near in all these respects to the gayal.

The colour is very nearly the same as in the latter, the head and body being blackish brown in both sexes, and the lower portion of the limbs white or yellowish. The horns are of uniform blackish tint from base to tip. Some gayals are parti-coloured, while others are completely white. The gayal stands much lower at the withers than the gaur, cows being much smaller than bulls, with scarcely any dewlap on the throat.

In a more or less domesticated condition large herds of gayal are kept by the Kuki tribes in the hill districts of Tippera; and some of the domesticated cattle kept by the hill tribes on both sides of the Assam valley, in the districts of Manipur, Cachar, Chittagong, and the Lushai Hills, are also gayal, although others are gaur. Very probably these tame gayal occasionally interbreed with gaur. The herds of gayal are kept for food, and, according to some authorities, for milk, although this is doubtful, since most of the Indo-Chinese tribes who keep mithans never drink milk. The animals, which appear to be never employed in agricultural labour or as beasts of burden, roam and feed unattended through the forest during the day, and return to their owners' village at night.



A BULL GAYAL

We sat down and held a council of war, and then I took up the tracks of the gallopers. Two miles off I found the beasts grazing peacefully, as if nothing had happened. Tracking in such circumstances is easy work, with debris to guide you all the way. I have usually found that gaur, when alarmed by a rifle shot or other cause, do not gallop for over three miles, but it is just as well to wait a little before you follow, as they are for some time very vigilant.

Many times calf gaur have fallen into my shikarees' hands, especially when cattle disease has been rife. Every effort has been made to rear them, but in vain. They have often lived for over three weeks and been nourished by domestic cattle; eventually, however, the calves died. The Bheels have a queer notion that artificial light, such as an oil-lamp, kills the calves, but I think that want of strong nutrition is the cause. They require such milk as no domestic beast can give them.

During the hot weather one rarely finds gaur on the plain. I have, however, killed a few bulls which have descended to the plain in order to reach another range of hills—in fact, they were taking a short cut from place to place. Where I killed most of my gaur was on plateaux rising from 2,000 to 3,000 feet above the sea. In the monsoon I have frequently found gaur on the plain, whither they had gone to escape from leeches or irritating flies. The gaur is far easier to find in the monsoon, owing to the rapidity with which one

THE YAK

Like gaur, gayal are essentially inhabitants of hill forests, and the facility with which they traverse rocky country is little short of marvellous for animals of such bulky proportions.

THE BANTIN

The bantin, or Javan ox, (*Bos sondaicus*) differs considerably from the gaur, which it serves in some degree to connect with typical oxen. The most distinctive feature of this species is the large white patch on the hind quarters, which extends upwards to the root of the tail, although not surrounding it. Another peculiarity of the typical bantin is that the cow has the head, body, and upper portions of the limbs of the same reddish brown, almost chestnut, colour as the calves.

The general build of the animal is slighter than that of the gaur, the ridge on the back is much less developed, and the legs are proportionately longer. The head is also more elongated and pointed; while the horns, which are cylindrical in the young, are relatively smaller. In the adult bull they are flattened at the base, and are much curved, the direction being at first outwards and upwards, although towards the tips they incline inwards and somewhat backwards; between their bases the forehead is covered with hard and somewhat horny warty skin. The tail descends below the hocks, and the dewlap is of moderate size.

In the typical Javan bantin the old bulls are black, with the exception of the white patch on the buttocks and the legs from the knees and hocks downwards. The young calves, like those of the gayal, have the whole length of the outer surface of the limbs chestnut, and they are also distinguished by a dark streak down the back. A full-grown bull bantin from Java measured 5 feet 9½ inches at the withers. In the Burmese race, or tsaine (*B. sondaicus birmanicus*), both sexes are usually a tawny chestnut throughout life, although they tend to become darker when adult and a few old bulls are stated to turn almost black. In some instances bull tsaine from Siam have the whole coat marked with small white flecks.

The bantin is confined to the regions lying to the east of the Bay of Bengal, occurring throughout Burma, and probably extending as far north as the hills eastwards of Chittagong, while it also inhabits the Malay Peninsula, the islands of Java, Bali, Borneo, and probably Sumatra, and also Siam. Large herds of domesticated bantin are kept by the Malays in Java, and also in the small island of Bali, lying to the south-east, which are replenished by importation from Java. These tame Bali bantin, in which the white area on the rump is reduced to a small patch on the hind surface of the buttocks, afford at least a considerable portion of the supply of beef to Singapore.

Red or tawny is probably the ancestral colour of the ox tribe, and the fact that both sexes of the Burmese and the cows of the Javan race permanently retain this original colouring, which is transient in the gaur, indicates that the present species is less specialised than the other, the dark colour being acquired only in the male of the typical race. This is confirmed by the structure of the bantin, which departs less widely from that of the typical oxen than is the case in the gaur.

Although the accounts of the habits of the bantin are not very full, it appears that in these respects this animal is very similar to the gaur. It has been suggested, however, that from its relatively longer legs the bantin is less addicted to climbing rocky hills than the gaur, and that it is accordingly more restricted to the plains; but this does not seem to be borne out by the accounts of sportsmen.

The extinct Etruscan ox (*B. etruscus*), from the Pliocene of the Continent, appears to have been allied to the bantin, but the horns of the bulls are placed low down on the skull near the eyes, and the cows are hornless.

THE YAK

The yak (*Bos grunniens*), which is one of many species of mammals peculiar to the elevated plateau of Tibet and the adjacent districts of China, differs markedly from all other members of the ox tribe, although to a certain extent it forms a connecting link between the preceding group and the bison. The most distinctive peculiarity of the yak, so far as external features are concerned, is the mass of long hair with which the flanks, under parts, limbs, and tail are clothed, and which makes the appearance of the animal very different from that of other cattle (page 524).

On the head and upper parts of the body the hair is short and nearly smooth, and the long hair only begins on the lower part of the sides, where it forms a fringe of great depth, extending forwards across the shoulders and backwards on to the thighs. On the tail the long hair is developed on the lower half, where it expands into an enormous tuft, which does not generally reach below the hocks. There is also a tuft of long hair on the breast. The colour of the hair in the wild yak is uniform dark blackish brown, sometimes tending to a rusty tint on the flanks and back, and with a grey grizzle on the upper part of the head and neck in very



A DOMESTICATED YAK

old individuals, and around the muzzle a little white. Many domesticated yak, especially those living at elevations much below that of the Tibetan plateau, are, however, black or brown and white, or even pure white.

In build the yak is massively formed, with short and stout legs. The shoulders are high, but there is not the distinct ridge on the back characteristic

of the gaur, and the whole back is nearly straight throughout, without any falling away at the hips.

Both the ears and the muzzle are small, and the dew-lap is totally wanting. The head is long and narrow, with a nearly flat forehead, and the eyes are approximated to the horns. The horns, which are very large in the bull, are smooth, and nearly or quite cylindrical, with the first curvature of their upper border concave, as in the gaur and bantin. They curve at first upwards and outwards, then sweep boldly forwards, after which they incline upwards and inwards, and in some cases slightly backwards. The hoofs are relatively large and rounded.

In height, old bulls occasionally stand nearly 6 feet at the shoulder; but 5 feet 6 inches may be taken as the average. The weight of bulls is said to be about 1,200 pounds. Averaged-sized horns vary in length from 25 to 30 inches, measured along the curve, but a pair has been recorded measuring 40 inches in length, with a basal girth of nearly 19 inches. The horns of the cows are always smaller and thinner than those of bulls.

Such are the leading external characteristics of the yak, but there are also certain features connected with the skeleton which are worthy of notice. In the first place, there are fourteen pairs of ribs, whereas, in all the species hitherto noticed, the number is but thirteen; and in this respect the yak resembles the bison. In the skull the region between the eyes and the occiput is relatively shorter and wider than in more typical cattle, and the horns are set on somewhat below the plane of the extreme summit. In consequence of this, the front view of the yak's skull exhibits a small prominence between the horns formed by a boss of bone at the top of the occiput; the crest or summit of the occiput itself being invisible from the front, and the shape of the whole occiput forming an inverted V. In regard to the position of the horns and some other features of the skull, the yak approximates to the bison.

Yak inhabit the plateau of Tibet, probably extending northwards as far as the Kuen-Luen range, while eastwards they range into the Chinese provinces of Sze-chuen and Kansu, and westwards enter the eastern portions of Ladak, especially the regions in the neighbourhood of the Chang-Chenmo valley and the great Pangkong lake. The greater portion of the country comprised within this extensive area is utterly desolate and dreary, but yak confine themselves to the wildest and most inaccessible portions of these regions, and are found only at great elevations, ranging in summer from about 14,000 to upwards of 20,000 feet, and perhaps even more, above the level of the sea. They are at all times extremely impatient of heat, and delight in cold.

The yak found nowadays in the Chang-Chenmo valley are chiefly or entirely stragglers from Chinese territory, and, owing to incessant pursuit, very few are to be met with in these regions. Native travellers,

however, report that on the upper Indus, to the east of Ladak, yak are to be found in vast numbers, and that there they do not exhibit the extreme wariness characterising those which wander into Ladak. In Northern Tibet yak were met with in great numbers by the Russian explorer Przewalski. Here the old bulls were found alone, and the cows and younger males in small herds; although where the pasture was good the herds were sometimes very large.

These herds wandered more or less regularly over wide tracts of country, and, according to native reports, are found in summer in grassy plains, where they are quite unknown in winter. As in Southern Tibet, they are especially partial to the tracts bordering the streams, where grass is more abundant than elsewhere. On the other hand, the solitary bulls are reported to inhabit the same districts throughout the year. Where the herds are largest, their numbers are said to be reckoned by hundreds, and even thousands. When alarmed or expecting danger, the cows and older bulls place themselves in the van and on the flanks of the herds, with the calves in the centre, but on the near approach of a hunter the whole herd

will take to flight at a gallop, with their heads down and their tails in the air. A wounded yak, whether cow or bull, will not infrequently charge.

A peculiarity of domesticated yak is the grunting voice, from which the Latin name *grunniens* was given; but the wild race, which it has been proposed to distinguish as *B. grunniens mutus*, does not utter these grunts. Domesticated yak are kept by the inhabitants of the higher regions of Tibet as beasts of burden and for the sake of their flesh, and are absolutely essential for crossing many parts of that desolate region. Some of the pure-bred animals kept by the Tatar tribes living on the Rupsu plateau, to the south of the Indus in Ladak, are magnificent beasts



A POLLED YAK

of large size and uniformly dark colour. When they have not been used for a considerable period they are very wild, and apt to break loose and throw their loads, but after a few days' march they sober down.

In other districts domesticated yak are smaller, and vary greatly in colour, being sometimes entirely white, while the tail is generally white. There are also many crosses between the yak and ordinary cattle, some of the breeds being without horns. These half-breeds have the advantage of being able to withstand much higher temperatures than the pure-bred yak, and they may be met with carrying burdens in the hot valley of the Indus, between the town of Leh and Kashmir. Although yak are admirable beasts of burden on account of their endurance and strength, and the facility with which they traverse glaciers and swim icy torrents, they have the great disadvantage that they will not eat corn. This frequently necessitates the pushing on of the party by forced marches to prevent their beasts from perishing of hunger.

THE BISON

THE BISON

The true, or European, bison, wisent, or the zubr (zubre) of the Russians (*Bos bonasus*), is one of two species representing a distinct and peculiar group or subgenus (*Bison*) of the genus *Bos*. These animals, of which there is a picture in colours on page 575, resemble yak in their cylindrical horns and the relative shortness of the forehead of the skull, and also in the large number of their ribs, of which there are fourteen or fifteen pairs. They differ, however, in having the horns placed more below the plane of the occipital region of the skull, so that in a front view the crest of the occiput itself is seen at the summit of the skull.

A further distinctive feature is to be found in the extreme convexity of the forehead of the skull, while the sockets of the eyes are very prominent, and assume a more or less tubular form. As a minor feature, it may be mentioned that the premaxillary bones, forming the extremity of the skull, are separated from the very short nasal bones by a much longer interval than in the yak and the gaur, and are thus widely different from those of the typical oxen, which are prolonged upwards to join the elongated nasals.

Bison are further characterised by the great excess in the height of the withers over the hind quarters, owing to the great length of the spines of the vertebræ in the fore part of the trunk. This produces a distinct hump on the shoulders, which passes, however, gradually into the line of the back without the sudden descent characterising the gaur. The great development of the fore quarters appears to be intensified by the mass of dark brown hair with which the back of the head, neck, shoulders, and chest are covered, and which extends far down on the fore limbs. The long hair is likewise continued as a kind of crest along the middle of the back nearly to the root of the tail; the tail itself being tufted at the end, and reaching some distance below the hocks. The remainder of the body is covered with short, curly hair of a somewhat lighter tint than that clothing the fore quarters. In summer the long hair over all the body is shed in large patches, thus showing the nearly bare skin clothed with short mouse-coloured hair.

The European and the American bison are very closely allied, and their distinctive differences may be best considered in the account of the second species, although it may be stated here that the European bison does not display that falling-off in the hind quarters so conspicuous in the American species. As already mentioned, the name aurochs, which belongs to the extinct wild ox of Europe, was long applied to the European

bison, but it may be hoped that this misapplication will soon be a thing of the past.

The European bison is a forest-dwelling animal, and was always absent from the open plains of Southern Russia, which in many respects resemble the habitat of its North American cousin. Formerly this species, as attested both by historical documents and by its semi-fossilised remains, was abundant over a large area of Europe, but it is now restricted to the forest of Bielowitza, in the Russian province of Grodno, formerly known as Lithuania, and the Caucasus, where it is known to the natives as the adompé, adombé, or dombai. Although its differences from the Lithuanian bison are slight, it has been separated as a local race under the title of *B. bonasus caucasicus*.

In the opinion of Dr. Max Hilzheimer, the Caucasian bison is really a distinct species (*Bos caucasicus*), with nearer affinities to the American bison (*B. bison*) than to the typical Lithuanian animal; and, surprising as this conclusion may appear, it seems to be supported by several features in the structure of the skull, more especially the flatness of the frontal region.

It is doubtful whether bison are now to be found south of the main chain of the Caucasus, the Kuban district being their headquarters. They occur in the mountainous districts of the Kuban region. A small number still remain on the Great Laba, the upper part of the Little Laba, and in Urushtem. Many remain on the upper Belaja and its upper tributaries, the Tschegs (Kypcha), Abago, and others. The greater number exist near the source of the Belaja, from the River Gaseripi to the Tschegs.

Fossil remains of bison are met with in the caverns and superficial deposits of England, France, Switzerland, Germany, and Italy; the earliest deposits in which

they occur being the brick-earths of the Thames valley, where they are associated with those of the mammoth, and in the still older Forest-Bed of the Norfolk coast.

This fossil bison (*B. priscus*) was of larger dimensions, and had longer and straighter horns than its existing representative. From Britain the bison disappeared at an earlier date than the aurochs, none of its remains occurring in the fens and turbaries, where those of the latter are so common. Northwards the range of bison formerly extended into Siberia, and their remains have also been obtained at Eschscholtz Bay, in Alaska.

The Lithuanian bison, so far as can be ascertained, appears to have always associated in small bands, which comprise from fifteen to twenty individuals during summer, although in winter two or more bands unite to form a herd of from thirty to forty head. The very



HEAD OF AMERICAN BULL BISON

From a photograph by Mr. Gambier Bolton, by permission of the Autotype Co., 74, New Oxford Street, W.C.

HARMSWORTH NATURAL HISTORY

old bulls are solitary. In spring and summer bison seek the thickest and deepest portions of the forest, but during winter frequent drier and more elevated covert. Whereas the nutriment of the American species consists wholly of grass, the European bison feeds largely upon the leaves, twigs, and bark of trees. Although active during both day and night, bison feed during the morning and evening. Large trees are stripped of their foliage and bark as high up as the animals can reach, while smaller ones are broken down or uprooted.

In spite of their size and bulk, bison are active animals, and can both trot and gallop with considerable

being essentially an inhabitant of the open plains, where it formerly congregated in vast herds, comprising thousands of individuals, and living entirely on grass.

The species differs from the European bison in the following features: The mass of hair on the head, neck, and fore quarters is much longer and more luxuriant, and thus gives the animal the appearance of possessing greater size than is really the case; the fact being that it stands lower, and has a smaller pelvis and much less powerful hind quarters than its European cousin, although its body is, on the whole, more massively built. It is this falling away of the hind



AMERICAN BISON ON A PRESERVE

From a photograph by permission of the New York Zoological Society

speed. In galloping the head is carried close to the ground, and the tail high in the air. Generally they are shy and retiring in disposition, more especially when young, but in the forest an old bull has been known to take possession of a road and challenge all comers. During the breeding season, in August or the early part of September, bison are in the best condition, and they are then fond of rolling in the dust. At such seasons the bulls engage in terrific conflicts, which occasionally end fatally, for the leadership of the herd. The old solitary bulls then return to the herds, and after having either driven away or killed their younger rivals, once more resume the leadership. Not only are the younger bulls sometimes killed in these conflicts, but the same fate occasionally overtakes the cows.

At the conclusion of the breeding season the old bulls revert to their solitary life. The calves are born in May or the early part of June, and are dropped in the most secluded parts of the forest. The cows apparently do not calve more frequently than once in three years, so that the rate of increase is necessarily slow. In defending their offspring against the attacks of bears and wolves the females display great courage, and seldom allow them to be carried off except at the sacrifice of their own lives. Occasionally when full-grown bulls get half buried in deep snow they are pulled down by wolves.

THE AMERICAN BISON

As the gaur in India has usurped the name of bison, while the European bison has been frequently called the aurochs, so the American bison in its native country is almost invariably misnamed the buffalo. The American bison (*Bos bison*) differs from its European cousin not only in certain structural features, but in habits,

quarters which detracts from the appearance of the species. Compared with *B. bonasus*, the horns are shorter and more curved, while the front of the head is more convex and the sockets of the eyes are less tubular. The tail is shorter and less bushy. As regards colour, the American is much darker than the European species, the coat of the former approaching black, while that of the latter is purplish brown, with a peculiar and characteristic bloom. An unusually fine bull American bison measured 5 feet 8 inches at the withers, but the average is considerably below this. Good horns measure from 16 to 17 inches, but a pair with a length of 20½ inches and a girth of 15 inches has been recorded.

The range of the bison originally extended over about one-third of North America. Starting almost on the Atlantic coast, it extended westwards through a vast tract of dense forest, across the Alleghany Mountains to the prairies along the Mississippi, and southwards to the delta of that river. Although the great prairies of the west were the natural home of the species, where it flourished most abundantly, it also wandered south across Texas to the burning plains of North-Eastern Mexico, westwards across the Rocky Mountains into New Mexico, Utah, and Idaho, and northwards across a treeless waste to the inhospitable shores of Great Slave Lake. Its maximum development was probably reached about the middle of the eighteenth century, and it has been surmised that, if left to itself, the bison would have crossed the Sierra Nevada and Coast Ranges to the Pacific slopes, while it would ultimately have developed into several distinct races according to the climate of the different regions it inhabited. The wood bison of the north-west (*Bos bison athabascæ*) is, indeed, now generally recognised as distinct from the typical

THE AMERICAN BISON

prairie animal. The opening up of the interior of North America with the advance of civilisation put an effectual stop to further modification of the species, and eventually led to its extermination on the prairies.

In regard to its former abundance, Mr. W. T. Hornaday observes that "it would have been as easy to estimate the number of leaves in a forest as to calculate the number of bison living at any time during the history of the species before 1870." As an instance of these enormous numbers, it appears that in the early part of 1871 Colonel Dodge, when passing through the great herd on the Arkansas, and reckoning that there were from fifteen to twenty individuals to the acre, stated from his observation that it was not less than twenty-five miles wide and fifty miles deep. This, however, was the last of the great herds, and it is estimated that the number of individuals comprising it could not be reckoned at less than four millions. Frequently the plains were absolutely black with bison so far as the eye could reach, and a train on the Kansas Pacific Railway was known to pass through a herd for a distance of 120 miles. Indeed, the trains were occasionally derailed, or "held up" until the vast mass of bison passed on.

With the progress of civilisation the bison was indeed foredoomed to disappear, but its end was hastened by the reckless way in which the animals were shot down for the sake of their hides or tongues; by the want of protective legislation on the part of the Government, the preference for the flesh and skin of cows, the stupidity and indifference to man of the animals themselves, and, lastly, the perfection of firearms. Herds have been settled in the Yellowstone National Park, where they are stringently protected by Government, and in other parts of the United States.

The breeding season is from the beginning of July to the end of September, and the calves are generally born from April to June, although occasionally so late as August. The cow does not breed till three years old, and sometimes produces two calves at a birth. For the first two months of its existence the coat of the calf is brownish yellow, although even at that period there are indications of the long hair covering the fore quarters of the adult. Young calves can be tamed with facility. In yearling bison the horns are in the form of straight, conical spikes, of from 4 to 6 inches in length; and these spike-like horns, with a curve at the base in older individuals, continue till the end of the fourth year, during which period the young males are termed "spike-bulls."

In these young bulls the horns are jet-black, but from scaling of the exterior and the accumulation of dirt they tend to become grey in the adult. With advancing age the outer layers of the horn begin to break off near the summit, until the whole horn becomes short, thick, and blunted, with only the tip of what was once a neat and shapely horn showing at the end. The bull is then known as a "stub-horn," and the horns increase in roughness and unsightliness as he grows older.

Towards the end of winter the coat assumes a faded and bleached appearance from the effects of the wear

and tear of the elements; and towards the end of February, or somewhat later, it begins to change, but the whole process occupies more than half the year. The shedding is accomplished both by the new hair growing into and forcing off the old, and also by the latter falling off and leaving the skin bare in great patches.

During the shedding process bison present an unsightly appearance, but by the end of June the whole of the old hair has fallen off and the body is bare, although the new dark hair is well grown on the head. During the summer their naked skin is scorched by the sun and bitten by flies, and bison consequently protect themselves by wallowing, and thus coating their hides with a plaster of dried mud. By the beginning of October the new coat of hair has attained considerable length, and between the 20th of November and the 20th of December the bison is in the full glory of his apparel, the contrast presented at this time to that during summer being most striking. In regard to weight, one adult bull scaled 1,727 pounds, but as it was by no means a fat specimen it is probable that this weight is exceeded.

In captivity American bison breed freely, not only with their own kind, but with other cattle. In the United States a herd has been established by crossing bull bison with domesticated cows; the cow bison not producing hybrid offspring. This hybrid race is fertile, either with itself or when again crossed with domesticated cattle, and it has been considered that a strain of bison blood might lead to the cattle in the North-Western States being better enabled to withstand the blizzards of those districts.

Subfossil remains of the American bison are found in various parts of North America, and in Texas occur



THE CAPE BUFFALO

those of the extinct broad-fronted bison (*B. latifrons*), distinguished by its superior size, and stouter and less backwardly inclined horns, while other more or less nearly allied species or races are met with in other parts of North America.

THE AFRICAN BUFFALO

The African buffalo (*Bos caffer*), as typified by the large black Cape race, is the first representative of a group of cattle distinguished by several well-marked characters. They are all heavily built animals, with thick and strong limbs, moderately long tails, tufted at the end, short necks, very broad muzzles, and large ears. The hair covering the body is always thin, and in old age leaves the skin almost entirely naked.

The horns, which are generally large and massive, are more or less distinctly flattened and angulated—at least at the base, where their cross-section is triangular. They are placed on the skull a considerable distance below the plane of the occiput; and their upper border is concave, with the tips turned inwards, the curvature being generally at first outwards and upwards. In the skull the forehead is more or less markedly concave, and the premaxillary bones reach upwards to join the nasals, as in the typical cattle. The number of ribs is thirteen pairs.

The Cape buffalo and its immediate relatives are the largest and fiercest members of the group found in the continent from which it takes its name. The typical Cape species is characterised by its blackish colour and the great massiveness of the horns, which are much flattened at the base, where they are expanded, so as to form in old bulls a kind of helmet-like mass, covering the whole of the upper part of the head, and with only a narrow line between them. From this expanded base the curvature of the horns is at first outwards, downwards, and backwards, and then forwards, upwards, and inwards; their smooth extremities being nearly cylindrical. The skull is characterised by its shortness, and also by the deep concavity of the profile below the horns; the nasal bones being extremely short, and the socket of the eyes not particularly prominent.

The head has a very large and expanded muzzle, and a characteristic hollow below the inner angle of the eye. The large flapping ears are thickly fringed on the lower border with hair; the upper border being sharply truncated before the descent to the pointed extremity. With the exception of the ears and the tip of the tail, the hair is very sparse, and it is only on the head and limbs that old bulls can properly be said to be haired at all. In the cows and young bulls, however, the hair is thicker, and its colour is dark brown, with a more or less reddish tinge. A well-grown bull buffalo will stand about 5 feet at the shoulder.

The horns vary in shape and size with the age of the animal. In regard to size, one of the largest pairs known had an extreme span from bend to bend, in a straight line, of 49 inches, with a depth on the forehead of 11½ inches. The typical Cape buffalo is usually found in reedy

swamps, but some individuals, said to be distinguished by their blacker hair and more spreading horns, inhabit forests. In Eastern Africa occur several races, such as *B. caffer radcliffei*, in which the horns are thinner and flatter than those of the Cape animal. From these there is a more or less complete transition to the brown Sudan buffalo (*B. c. equinoctialis*), in which the general colour is reddish brown, while the horns of the bulls are less thickened on the forehead, and separated in the middle line by a considerable interval. In Senegambia

occurs the smaller *B. planiceros*, which in its turn leads on to the red West African races noticed in the sequel.

Before their numbers were thinned by the sportsman's rifle and the rinderpest, the Cape buffalo and its immediate relatives were usually found in herds of from fifty to two hundred, or even three hundred, individuals. Old bulls are frequently met with alone, although they more usually associate in parties of two, three, or four, while occasionally from eight to ten may be seen together.

These small parties

of bulls are said to be much less wary, and consequently much more easy to approach, than large herds of cows, and solitary bulls are not regarded as more dangerous than other members of the species. For animals of such heavy build and bulk, these buffaloes are remarkably swift, and it requires a good horse to keep ahead of a charging buffalo even in the open, while in covert, unless very fleet, a horse stands a good chance of being overtaken. Cape buffaloes are commonly represented as charging with their heads lowered to the ground and their tails raised high in the air; but this is incorrect, and when charging they invariably hold their noses straight out, and lay their horns back over their shoulders, lowering their heads just as they strike.

The Cape buffalo breeds during the African summer, the young being born from January to March, and there being apparently never more than one at a birth. The calf is hidden in long grass, and for about ten days after its birth the cow separates from the herd, and remains within a short distance of her offspring, which she visits at intervals. In regard to the age to which buffaloes live, it is stated that old, solitary bulls have been known as such for twelve years, and it is therefore considered probable that the full age may be about thirty years.

In West Africa the species is represented by smaller animals, with short and widely separated horns, of which the best known is the dwarf red buffalo (*B. c. nanus*) of the Congo territory. More or less nearly allied to this race is the Sierra Leone buffalo, a specimen of which was exhibited in the Zoological Gardens at Antwerp in 1875; it was light yellow above, but reddish on the under parts, with a sharp line of demarcation between the two areas. The horns are but little



RED CONGO BUFFALOES

THE INDIAN BUFFALO

flattened, and are separated from one another by a wide interval on the forehead, and have a simple curvature.

In the red Congo buffalo, on the other hand, the horns are more flattened and expanded at their bases, where they are more or less approximated in the middle line, while their tips are curved sharply upwards and inwards, terminating in a point. From this Congo race there appears to be a transition through the darker and browner Sierra Leone buffalo to the Senegambian *B. c. planiceros*, and from the latter to the Sudan *B. c. æquinoctialis*, which, in its turn, apparently passes into the eastern representatives of the species.

The general colour of the Congo buffalo—the bush-cow of the Europeans on the West Coast, and the nidri of the natives—is bright orange red, the hair on the body being of considerable length, while the ears are heavily fringed with still longer hairs. In stature the bulls stand only about 42 inches at the shoulder, and the horns range from 11 to 23 inches in length, with a basal girth of from 10 to 13 inches.

The Congo buffalo, which is essentially a forest animal, is found both in the plains and in the mountains of West Africa, where it is far from uncommon. It possesses a speed almost equal to that of the larger antelopes, and when in thick covert is very difficult to drive out, except with the aid of dogs. Otherwise there does not appear to be anything specially noteworthy in its habits.

Here it may be mentioned that both in Algeria and at the Cape are found in the superficial deposits skulls of buffaloes allied to the existing species, but with very long horns, which did not meet in a helmet-like mass on the forehead. In an Algerian skull the length of the bony horn cores measured along the curve is fully 11 feet, while in one of the species or races, known as *B. baini*, from the Cape the length is estimated at upwards of 14 feet, measured along the curve. When covered with their horny sheaths, the horns would, of course, be still longer.

INDIAN BUFFALO

The Indian buffalo (*Bos bubalis*), or arna, as the male is called in India, is very different in appearance from the African species, being characterised by the much greater proportionate length of the head, of which the profile is nearly straight and the centre of the forehead markedly convex (page 626). In the skull the sockets of the eyes are very prominent, and the nasal bones are of much greater length than in the African species. The ears of the Indian buffalo are also much smaller and less open, with only a very slight fringe of hair on their edges. Still more distinctive are the horns, which are

very long, much flattened, and angulated throughout the greater part of their length, with strongly marked transverse wrinkles, and a distinctly triangular section. They taper gradually from root to tip, and generally curve regularly upwards, outwards, and a little backwards from the line of the face in nearly a single plane, the tips bending inwards and slightly forwards. In a race from Assam the horns are directed straight outwards for the greater part of their length, and then suddenly curve upwards. In cows the horns are considerably longer and thinner, with a much less marked angulation in front, than in the bulls.

In common with all other Asiatic buffaloes, the hair on the middle line of the back, from the loins to the head, is directed forwards. The body becomes almost bare in old animals, and the colour is ashy black, although the legs may be whitish, or even in domesticated breeds quite white below the knees and hocks. There is, however, a dun-coloured variety from Upper Assam, in which the forehead is more convex than ordinary and the nasal bones of the skull are much shorter.

Very large bulls are stated to stand as much as 6 feet 2 inches at the withers, but many are much smaller, and in one, of which the height was 5 feet, the length from the nose to the root of the tail was 9 feet 7 inches, that of the tail 3 feet 11 inches, and the girth 8 feet 3 inches. In the same specimen the length of the horns, measured from tip to tip along the outer curve, was 8 feet 3 inches. A skull in the British Museum of the straight-horned race has, however, horns measuring 12 feet 2 inches from tip to tip along the curve, while in a pair of detached horns in the same

collection each has a length of 6 feet 6½ inches, which indicates a span of about 14 feet from tip to tip.

In a truly wild state the Indian buffalo is definitely known solely in the country from which it takes its name. As regards the herds found in a wild state in Burma and the Malay Peninsula and adjacent islands, it has been suggested that they are descended from animals escaped from captivity, but there seems no sufficient reason why these also should not be aboriginally wild. The race inhabiting Java is known as karabu.

In India wild buffaloes are found on the plains of



SMALL-HORNED INDIAN TAME BUFFALOES

the Bramaputra and Ganges, from the eastern end of Assam to Tirhut; they also occur in the Terai land at the foot of the Himalaya, as far as Rohilkhand, as well as on the plains near the coast in Midnapur and Orissa, and in the eastern portions of the Central Provinces, as well as in the north of Ceylon. Domesticated buffaloes are found not only over the whole of India and Burma, and the greater part of the Malay region,

but have been introduced into Asia Minor, Egypt, Turkey, Hungary, and Italy.

The haunts of the wild Indian buffalo are the tall grass jungles found in many parts of the plains of India, and generally in the neighbourhood of swamps; but buffalo may also be found more rarely in the open plains of short grass, or among low jungle, and occasionally even in forest.

In their wild state these buffaloes are always found in herds, which may comprise fifty or more individuals. Dr. W. T. Blanford states that "they feed chiefly on grass, in the evening, at night, and in the morning; and lie down, generally in high grass, not unfrequently in a marsh, during the day; they are by no means shy, nor do they appear to shun the neighbourhood of man, and they commit great havoc amongst growing crops."

The calves are born in summer, and there are often two at a birth. In walking, the Indian buffalo always carries its head low.

In India, as elsewhere, domesticated buffaloes have departed very little from the wild type, and never interbreed with the native humped cattle. Nevertheless, a number of distinct breeds occur in India, distinguished by differences in stature, the relative size and shape of the horns, and colour. In the Malay countries tame buffaloes of the long, straight-horned type are known, and a somewhat similar breed is found in the Deccan. The Gujerat buffalo is very similar in appearance to the straight-horned Deccan breed, but has horns of a different type. Another type, both as regards head, horns, and bodily size and build, is presented by the Gir, or Kathiawar, breed, in which the horns are bent down by the sides of the head. Another large buffalo is the Delhi breed, which has now spread over the provinces of Agra and Oudh, the Punjab, Rajputana, and Sind. The buffaloes working in the rice fields of Bengal are a very small breed, with horns of the circular type.

The South Indian buffalo is likewise a small breed, specially characterised by its neat, compact build and active habits. Similar features characterise the buffaloes that get their living by grazing on the steep slopes of the outer Himalaya. These buffaloes are fairly gentle in disposition, but bulls of the breed inhabiting the Nepal frontier will charge a European or a horse without provocation. In the Simla district, and on the route to Kashmir, a breed very similar in appearance to the last mentioned, but of much more peaceable disposition, is to be met with, and there are several others.

Into Eastern Europe, buffaloes, or water buffaloes, as they are called by some writers, are believed to have been introduced by the Longobards. Large herds of

them may be seen on the marshes bordering the Danube. Remains of a large race of the Indian buffalo (*B. bubalis palæindicus*) occur fossil in the gravels of the Narbada valley, and in parts of the Punjab. The broad-horned buffalo (*B. platyceros*) of the Siwalik Hills of Northern India was, however, a perfectly distinct species, characterised by the broad triangular horns being placed closer together on the forehead, and directed rather forwards than backwards, so that the forehead is nearly flat; they are also placed more below the plane of the occiput. Other extinct Siwalik buffaloes (*B. occipitalis* and *B. acuticornis*) are of smaller size, with skulls like those of the tamarao and anoa; the horns rising upwards in the plane of the face, with slight divergence or curvature, and their cross-section either triangular or pear-shaped.

THE TAMARAO

The tamarao (*Bos mindorensis*) of the island of Mindanao in the Philippines, is a sturdily built dwarf buffalo, connecting the Indian species with that next described. It stands about 3½ feet in height, and has coarse, thick, blackish brown hair. The horns, which, although massive, are comparatively short and rise upwards in the plane of the face with a lyrate curvature, are distinctly triangular, with the largest face in front, and are somewhat roughened.

THE ANOA OR PIGMY BUFFALO

The anoa, or pigmy buffalo (*Bos depressicornis*), of Celebes is the smallest and most slenderly built of all wild cattle, and considerably inferior in size to a



THE ANOA

Highland cow, its height being about 3 feet 3 inches, with the hind quarters rather higher than the withers. The horns are ringed and triangular at the base, of considerable length, sharply pointed, and rising upwards in the plane of the face, with a small divergence and curvature.

They are situated much below the plane of the occiput, and consequently rise near the eyes; in old males they may be as much as 15 inches in length, but in cows are always small. The hind part of the skull is more like that of an antelope than a buffalo, having no distinct crest on the occiput. The ears are small, haired at the base, but naked at the tips, with a bunch

of white hairs internally; and the skull narrows towards the muzzle. The tail about reaches to the hocks. The general colour of the hair is dark blackish brown, lighter below, but there may be two spots of white on the sides of the head below the eyes, while the lower part of the legs and the back occasionally show white markings.

An anoa is very like a young Indian buffalo, and it agrees with the members of that group in its triangular

SHEEP

horns, the short and sparse hair of the adult, the large and naked muzzle, and the barrel-like form of its body. It also resembles those animals in its bovine smell, its fondness for water and shade, and its habit of drinking by long draughts instead of by short gulps.

On the other hand, the anoa approximates to the antelopes in its slender build, the structure of the hind part of its skull, the upright direction and straightness of its horns, the frequent presence of spots on the head, and its small size. In connection with the aforesaid fossil species from the Siwalik Hills, the anoa indicates a connection between antelopes and buffaloes; and from these primitive antelope-like buffaloes the other more specialised groups of cattle may have been developed.

Young anoas have a thick coat of woolly hair, which may either be of a bright golden or a dark blackish brown in colour, this juvenile coat coming off in large fleece-like masses, and being replaced by one of short hair, which is usually black, although in some of the cows it may also be brown. In very old bulls even the short coat may disappear more or less completely, when the black hide becomes nearly as bare as that of an ordinary domesticated Indian buffalo.

Adult anoas also display some variation in colouring.

In a pair living in Madras, the female had two large, irregularly shaped white spots on each side of the face, a large white patch on the chest, and extensive white markings on the legs, more especially the front pair. The male, on the other hand, was wholly dark-coloured, with the exception of white knee-caps. This might be taken as an indication that all bulls are without white spots, and that the latter are characteristic of all cows; but this is not the case, as whole-coloured and spotted individuals of both sexes are known. A bull in the British Museum is, for instance, wholly black, and the same was the case with a bull and a cow in the Duke of Bedford's park at Woburn. On the other hand, there is a considerable probability that these variations indicate the existence of two races of pigmy buffaloes, one of which is wholly black when adult, while the other has the white markings. This was suggested in 1889 by Dr. K. M. Heller, who pointed out that as Celebes is a large island, extending over $8\frac{1}{2}$ deg. of latitude, and embracing a land area of 3,300 square miles, there is a probability of its containing more than one kind of anoa.

The name *B. depressicornis fergusonii* has been proposed for the race with white markings on the face, chest, and legs. If it be eventually found that small size and the frequent presence of a brown coat in the females and of a golden one in the calves are additional characteristics of the white-marked race, its claims to distinction will be proportionately increased.

Pigmy buffaloes are denizens of remote wooded mountains, and the cows, which then keep apart from the bulls, produce their calves in the densest covert. At other seasons they seem to associate in couples, unlike other buffaloes. They are extremely shy and difficult to detect, and it is doubtful whether they have been seen alive by Europeans in the wild state. The natives of Macassar believe that, instead of lying down on the ground, anoas climb trees, where they sleep on a kind of platform.

SHEEP

The domesticated sheep of Europe are the typical representatives of a group of ruminants distinguished by several important characters from cattle, but passing almost imperceptibly into goats. They are of smaller size than the majority of cattle, and, although

comparatively short-necked, carry their heads higher above the level of the back. Both sexes are usually furnished with horns, but whereas those of the males are large and frequently extremely massive at the base, those of the females are small and narrow.

In the rams the horns are generally more or less triangular in section, and marked by parallel transverse wrinkles, while their colour is greenish or brownish; they are directed outwardly from the sides of the head, their upper border being at first always convex, and the curvature generally taking the form of an open spiral, with the tips turned outwards. The face has generally, but not always, a small gland below the eye, and there is a corresponding depression in the skull for its reception; and the muzzle differs from that of cattle in being pointed and covered with short hair. Another distinctive feature of the group is the presence of a small gland in each foot between the hoofs; and the females have only two teats in place of the four of cattle.

The males of all sheep are devoid of any strong odour; neither have they any beard on the chin. As a rule, in wild species the tail is very short, but in one case it reaches just below the hocks. The ears are of moderate length; and the hair in wild species is short and stiff, although it may be elongated on the

throat and fore quarters. The upper molar teeth differ from those of cattle in having narrow crowns without any additional column on the inner side. The feet have only the upper ends of the lateral metacarpal and metatarsal bones remaining, in the shape of splints on each side of the cannon bone.

As regards the characters of their molar teeth, sheep resemble gazelles, and it is accordingly not improbable that they may trace their descent to extinct antelopes more or less nearly allied to that group. Cattle, on the other hand, having molar teeth nearly similar to those of the sable antelope and oryx, might be supposed to be more allied to the ancestors of that group.

Sheep are represented at the present day by several wild species, which are mostly inhabitants of Europe and Asia northwards of the outer range of the Himalaya, although one species occurs in the Punjab and Sind, and a second in Northern Africa, while the bighorn is typically North American.

They associate either in parties of two or three, or in flocks of considerable size, and are essentially mountain animals. Very generally, however, sheep inhabit the more open districts, rather than the craggy and steeply scarped regions selected by goats.

Most of the species are nearly related to one another, and in several instances it is difficult to determine whether certain forms ought to be regarded as distinct species or merely as local races. Geologically, sheep are even a more modern group than cattle, none being definitely known to occur before the epoch of the Forest-Bed of the Norfolk coast, which belongs to the upper part of the Pliocene or the lower part of the Pleistocene period.

THE BIGHORN

The Rocky Mountain wild sheep, or "bighorn" (*Ovis canadensis*), as it is locally called, is the typical representative of a group of closely allied races or species common to the northern parts of both the Western and the Eastern Hemispheres. Whether they are best regarded as races or species is a difficult, and at the same time unimportant, question. In this work they are classed as races, a plan which has the advantage of indicating their wide geographical range. Bighorns differ in several respects from other sheep, notably in the horns of the rams, which, while very



Bones of left fore foot of sheep

large and massive, are distinguished by the slight development of the wrinkles on their front surface, and the great prominence of the outer front angle, and the rounding-off of the inner one. In the skull the depression for the gland below the eye is extremely shallow; and both in this respect and in the smoothness of their horns these species show an approximation to goats.

The typical bighorn is a large and handsome sheep, with the summer coat of a light brown colour, often showing a reddish tinge, while in winter it is bluish grey on the upper parts. The under parts, as well as portions of the legs, are white, and there is a large and conspicuous white patch on the rump, which extends upwards on each side of the tail. The back has a more or less distinct dark stripe, reaching to the tail, the latter being very short, and black above. The end of the muzzle is light-coloured. Beneath the hair there is a shining white under fur. Rams, which when old may become very light-coloured, attain a height of about $3\frac{1}{2}$ feet at the withers, and their average weight is about 350 pounds, or rather less. Ewes stand about 3 feet in height, and weigh about a third less than rams.

The length of horns in good specimens, measured along the curve, varies from 33 to 36, or even 40 and 41 inches, the broken tips frequently rendering them shorter than they would be if perfect. A horn measuring 33 inches in length has a basal girth of 16 inches; while in a second, of which the length is 40 inches, the basal girth is only $15\frac{1}{4}$ inches.

Inclusive of its local races, the bighorn extends in America from Mexico to Alaska, and from the eastern flanks of the Rocky Mountains to the Pacific coast; although there are some mountain ranges within this area upon which it has never been observed. Along the valleys of the Missouri and Yellowstone rivers it extends, however, some four hundred miles to the east of the Rocky Mountains, inhabiting the so-called Bad Lands of those districts.

As this Bad Lands sheep differs slightly from the typical Rocky Mountain animal it has been separated as a distinct race, under the name of *O. canadensis auduboni*. The typical race, of which the colour has been already mentioned, is characterised by its large skull and very massive horns, the tips of the latter being generally broken and directed forwards. The ears are large, broad, pointed, and deer-like, with hair of only moderate length.

In Alaska, on the other hand, there occurs a white or yellowish white race (*O. c. dalli*), in which the skull is smaller, and the horns are less massive, with their tips generally entire, and directed outwards. The ears are small and thickly furred, with blunted extremities; and there is a tuft of long hair between the ears at the back of the horns. This white bighorn inhabits the mountains of Alaska north of latitude 60° to the Arctic coast. In the Rocky Mountains eastward of Dawson City it is replaced by a nearly allied race (*O. c. fannini*), in which the shoulder, back, and the upper portion of the limbs are greyish in colour.

A contrast to these white and grey races is formed by the black bighorn (*O. c. stonei*), of the Cassiar and Stikine Mountains, in which the upper parts, except the rump patch, are deep blackish brown, this being one of the handsomest of all the bighorns. These races appear to intergrade.

These sheep were formerly found in large flocks, but are now rapidly diminishing in numbers, so that where they were at one time found in bands of several hundred individuals it is now rarely that more than fifty are seen together. Sentinels are posted in prominent positions to give notice of the approach of danger, and the agility of these sheep in making their way over glaciers and crags is said to be unsurpassed. It is stated that flocks of these sheep have on more than one occasion been known to leap down a precipice 150 feet high.

In summer they occasionally ascend as high as 1,200 feet, but in spring wander into the valleys in search of fresh pasture or salt lakes. The lambs, which are occasionally two at a birth, but usually one, are produced in May and the beginning of June, and when only a few days old will follow their mothers up apparently inaccessible cliffs. The flesh of this sheep is said to be equal in flavour to the best venison.

The Kamchatkan bighorn is so closely related to the northern races of the American species that it may be regarded as another geographical race, under the name of *O. c. nivicola*. It resembles the white bighorn in its relatively small skull and slender horns with entire and outwardly directed tips, and in the presence of a tuft between the small hairy ears. The ears of the Kamchatkan sheep are,

however, rounded instead of blunt, and the white patch on the rump is smaller than in the typical American bighorn, and does not extend above the tail, while there is no trace of a dark stripe down the back.

A second Asiatic representative of the group is the Siberian bighorn (*O. c. borealis*) of the Stanovoi Mountains, to the north of the Sea of Okhotsk, which differs from the Kamchatkan race by its lighter colour, especially in the female, and the much larger white patch. In Kamchatka bighorn were formerly abundant on the eastern coast, about fifty miles to the north-east of Petropaulovsk. They stand about 3 feet

4 inches at the shoulder on the average, and good horns measure about 38 inches along the curve, with a basal girth of 14 inches. The general colour is a brown grey, the head and neck rather greyer than the rest of the body.

THE ARGALI

The magnificent wild sheep of Central Asia typified by the argali (*Ovis ammon*) of the Altai Mountains represent a group distinguished from the bighorns by the characters of the skull and horns; the skull having a much deeper pit for the gland below the eye, while the front surfaces of the enormous horns are marked by a number of fine transverse wrinkles, and their front outer angles are much less prominent, although the inner ones are distinct. The argali group



ROCKY MOUNTAIN BIGHORNS

THE ARGALI

is represented by quite a number of closely allied forms of big wild sheep from Central and North-Eastern Asia, all of which are best regarded, like the bighorns, as local races of a single variable species.

In addition to their enormous horns, argalis, which may be compared in size to medium-sized donkeys, are characterised by small ears, very short tails, short summer coat, and the density of the longer winter dress. The typical Altai argali is a kind of whitey brown colour in the summer coat, with the face nearly white; in the winter coat rams of the Tibetan argali grow a large ruff of long white hairs, which appears to be much less developed in the Altai sheep. The colour of these sheep in winter is greyish brown above, but whitish beneath; and in the males there is, as a rule, a large white patch surrounding the tail and embracing a considerable portion of the rump, while the throat, chest, and under parts, as well as the inner sides of the legs, are also white. The crest of hair on the neck and a stripe down the outer side of the legs are dark, and there is also a dark mark above the tail. In very old rams the fur of the back becomes greyish by the mixture of white hairs.

Ewes have quite small, thin, and widely separated horns, and lack a distinct throat fringe in winter, while the light rump patch is indistinct. In colour the massive and closely wrinkled horns of the rams are light yellowish brown. Adult rams of the Tibetan argali stand from $3\frac{1}{2}$ to 4 feet at the shoulder. In ewes the horns are seldom more than 18 inches in length, but it is stated that they may occasionally reach 24 inches.

The term argali is the Mongolian name of these sheep, which are known to the Kirghiz as arkal. The Tibetan argali (*O. a. hodgsoni*)—the nyan (female nyanmo) of the Ladakis—inhabits the Tibetan plateau from Northern Ladak to the districts northwards of Sikkim, and probably still farther to the east. It is unknown to the south of the main axis of the Himalaya, and in summer does not descend below an elevation of fifteen thousand feet, but in winter may occasionally come as low as twelve thousand feet.

The typical Altai argali is stated to inhabit mountains at an elevation of from 3,000 to 4,000 feet above the sea, which have an abundance of naked rocks, but have their slopes thinly covered with forest, and their valleys wide and open. Here these sheep dwell throughout the year, rarely travelling from one mountain range to another; a single flock, when undisturbed, frequently inhabiting one and the same mountain for many successive years. Up to the breeding season the rams and ewes keep separate from one another, the former generally going in parties of from three to five individuals, while the latter are found singly; but shortly before that time the two sexes assemble in flocks of from ten to fifteen. They appear to be diurnal in their habits, feeding in the morning and evening on the mountain slopes and valleys, and

retiring to rest about midday. Both when feeding and sleeping, sentinels are placed to warn the flock of danger.

In summer argali feed on grass and various herbs, but in winter they are compelled to subsist on moss, lichen, and dry grass. Young ewes almost invariably give birth to a single lamb at a time, but the older ones frequently have twins.

The breeding season is in the winter, when these sheep collect in the lower and more sheltered valleys, and the young are born in May or June. The flesh of the nyan is excellent, being dark-coloured, fine-grained,

and well-flavoured. In Ladak the chief haunts of this splendid sheep are the Chang-Chenmo valley and the neighbourhood of the Pangkong lake, and thence into Chinese Tibet.

Discovered by the famous Venetian traveller Marco Polo so long ago as the latter part of the thirteenth century, it was not until 1873 that the great wild sheep of the Pamir (*O. a. poli*) became fully known to science, although it was named in 1840 from a horn obtained during Lieutenant Wood's journey up the Oxus.

The Pamir argali, or Marco Polo's wild sheep, although furnished with longer horns, does not appear to attain quite such large dimensions as the Altai and Tibetan argalis, from which it is mainly distinguished by

PAMIR ARGALIS, OR MARCO POLO'S SHEEP



the form of the horns. In the male the horns, when viewed from the side, are seen to form a spiral of about a circle and a quarter, and when adult are much longer than those of the typical argali, although less massive at the base. In fine specimens the horns may measure from 50 to 60 inches in length along the curve, with a basal girth of about 15 inches; a specimen has, however, been recorded measuring 63 inches in length, while one pair attained the enormous length of 73 inches, with a basal girth of $16\frac{1}{4}$ inches, and another 75 inches, with a girth of 16 inches. Ewes have small, upright horns.

The colour of the winter coat on the upper parts of the rams is light brown, with a more or less marked reddish tinge, but there is a dark line of longer hair extending from the nape of the neck to the withers, which in the females is sometimes continued as a stripe down the back. The muzzle, together with the fore part of the neck, the chest, the under parts, the rump inclusive of the tail, and the legs, is white. The patch of white on the rump is irregular of contour, and sometimes there may be a small black mark on the upper surface of the tail. The summer dress is lighter in colour. The ewes differ in the absence of any white on the throat. In addition to the long hairs on the nape of the neck, the old males have a more or less marked ruff on the throat.

In an adult of the closely allied Turkestan ram (*O. a. karelini*), in which the horns had a length of 48 inches, the height at the withers was 3 feet 8 inches, and the length from the horns to the tip of the tail 5 feet 2 inches, of which $5\frac{1}{2}$ inches were taken up by the tail itself.

HARMSWORTH NATURAL HISTORY

In habits these wild sheep are almost or exactly similar to the Tibetan argali. They live, however, in a far less barren country than the latter; the undulating slopes of the Pamirs being covered in summer with a continuous carpet of rich grass. The breeding season occurs in winter, during December and January, at which period some of the flocks may be very large.

Remains of extinct argalis occur in the Norfolk Forest-Bed and in deposits of Pleistocene age on the Continent.

THE URIAL, OR SHAPO

The Asiatic wild sheep known in the Punjab as the urial, but in Ladak as the sha, or shapo (*Ovis vignei*), belongs to a group distinguished from both the preceding species by the smaller size and less massive horns. It was long considered that the urial of the Punjab and other districts of North-Western India was specifically distinct from the shapo of Ladak, but it is now known that the two forms are so nearly related that they must be regarded merely as races of a single species. Other races occur in Baluchistan, Turkestan, and neighbouring countries.

The typical urial of the Punjab stands about 2 feet 8 inches in height at the shoulder, but the Ladak race is rather taller, its height being as much as 3 feet, or even rather more. The horns are strongly wrinkled, and have their lateral surfaces not much broader than the front one, but the extent to which their front angles are rounded off varies. The two horns rise close together, and curve round in a regular circular sweep, sometimes keeping almost entirely in the same plane, but at others forming a spiral; the curve very seldom exceeding one complete circle. In the ewes the horns are short and nearly straight.

The average length of the horns of the rams varies from 24 to 30 inches along the curve, with a basal girth of about 10 inches; but in one remarkably fine specimen the length of the horns is 39 inches, and their basal girth 11 $\frac{3}{4}$ inches. In the shapo of Ladak the horns are generally thicker at the base than in the true urial, their basal girth in some instances varying between 11 and 12 inches, whereas in the latter it does not exceed 10 inches; the horns frequently form a wider circle, and their front angles are more rounded off.

The adult ram of the typical urial is characterised by having a large ruff of long hair on the throat, beginning on each side of the chin in two tufts, which soon unite and extend down the throat to the chest. In the Ladak race the ruff seems less developed. In colour the fur of the urial is rufous grey or fawn on the upper parts in the summer dress, but in winter becomes greyish brown; the under parts, together with the rump, tail, and legs, are whitish; while in old rams the ruff is white in front, passing into black behind. There is a dark brown or black patch behind the shoulder, and sometimes a blackish line dividing the white of the under parts from the darker area, as well as blackish markings on the limbs. The ewes and young rams are of a uniform greyish brown colour.

The geographical range of the urial, using this term as comprising the whole species, is very extensive, and includes districts with exceedingly different climatic conditions. The large race known as the shapo extends from Northern Tibet through Ladak and Zanskar, where it is found at elevations of from 12,000 to 14,000 feet, and through Astor and Gilgit—where it is locally known as the urin—to Afghanistan. The true urial, on the other hand, inhabits the Salt Range of the Punjab, and perhaps Sind; but in the Suliman Range, the Hazara Hills, the neighbourhood of Peshawur, Baluchistan, and Afghanistan is replaced by a nearly allied race with more open horns, known as *O. vignei blanfordi*; while on the Kopet-Dagh Range, between Turkestan and Persia, is found a more distinct race, *O. vignei arkal*, characterised by the flat front surface of the horns of the rams, which are sharply angulated at the sides.

In Ladak urial inhabit open valleys; in Astor and Gilgit they keep to grassy ground at moderate elevations below the forest; but in the Salt Range of the Punjab, and in Sind, Baluchistan, and Persia they are found on undulating or hilly ground cut up by ravines, and are more often seen on stony and rocky hillsides than amongst bushes and scrub. The flocks vary usually from three or four to twenty or thirty in number; the sexes are generally together, but the males often keep apart in summer. These sheep are wary and active, and although not such masters of the art of climbing amongst precipices as goats, tahr, or bharaal, they get over steep places with wonderful ease. Their alarm cry is a shrill whistle, their usual call a kind of bleat.



YOUNG PERSIAN URIAL

In the Punjab the breeding season is in September, but it must be considerably later in Astor, where the lambs are born early in June. There are either one or two young at a birth; and the species will freely interbreed with domesticated sheep. The Punjab and Sind urial inhabits a hotter area than any other species of wild sheep, except the udad; and it is remarkable that a single species should have been able to adapt itself to climates so different as are those of the Punjab and Ladak.

In the Salt Range of the Punjab urial may occasionally be seen grazing with domesticated sheep; but they are soon disturbed by the sight of a European. The broken nature of the ground, with numerous sharp ridges, separated by deep and narrow ravines, renders urial stalking a comparatively easy sport.

THE RED, OR GMELIN'S, SHEEP

The red, or Gmelin's, sheep (*Ovis orientalis*) and the mouflon are comparatively small species, distinguished from the urial by the general absence of horns in the ewes, the want of a distinct ruff on the throat of the rams, and the finer wrinkles on the front of their horns, as well as by the tail being always dark-coloured. The red sheep, which inhabits Eastern Persia and Asia Minor, is, in its typical form, the larger of the two, rams standing about 2 feet 9 inches at the shoulder.

MOUFLON



MALE AND FEMALE HYBRIDS, BETWEEN MOUFLON AND DOMESTICATED SHEEP

Occasionally wild mouflon will desert their own kin to live among tame sheep.

The colour of the upper parts of the body in the rams is russet yellow, with a whitish saddle-mark on the back, the fore portion of the head being whitish, and the under parts, insides of the limbs, and the whole of the lower portions of the legs, as well as a streak on the buttocks, white. There is a dark mark on the front of the fore legs above the knee, and the fringe of long hair on the lower part of the throat is also dark, as is the end of the tail. The horns have a peculiar backward and inward curvature, so as nearly to meet behind the neck, and, as a rule, do not exceed 30 inches in length; but a pair has been recorded measuring 40 inches. The direction of the spiral of the horns is the reverse of that obtaining in the urial, the right horn forming a left-handed spiral, and *vice-versâ*.

The typical race of the species appears to be the one from the Elburz Mountains of Persia, which has comparatively little white, and that somewhat dirty, on the face and lower jaw. In the Armenian race, *O. orientalis gmelini*, of Armenia and Transcaucasia, the lower front angle of the horns is apparently more bevelled off than in the Persian sheep. The race inhabiting Anatolia, at the western extremity of the peninsula of Asia Minor, is known as *O. o. anatolica*, but its distinctive characters are not yet defined.

Heads from the Cilician Taurus appear to be distinguished by the large extent and purity of the white on the muzzle and under surface of the lower jaw, and the clearly defined white flecks over the eyes. In the large amount and purity of the white on the head the Cyprian race, *O. o. ophion*, resembles the Cilician type, but is markedly inferior in size, and further distinguished by the almost complete bevelling away of the lower front angles of the horns of adult rams. Lastly, the red sheep inhabiting an island in Lake Urmî, Persia, has been described, on the evidence of the horns, as a distinct race under the name of *O. o. urmiana*.

The Cyprian race, which inhabits the Troôdos Mountains of Cyprus, is the smallest of all wild sheep, the rams standing only just over 26 inches at the shoulder, and their horns not exceeding 23 inches in length.

THE MOUFLON

The European mouflon (*Ovis musimon*), now confined to the islands of Sardinia and Corsica, is the last member of the typical group of wild sheep (page 628). In height rams stand about $27\frac{1}{2}$ inches at the withers, and the build is compact and neat. The hair is short and close on the body, with an abundant under wool, but in the rams is elongated into a short mane on the neck and fringe on the lower part of the throat. With the exception of a dark brown line down the back, and a conspicuous light grey saddle-like patch on the back and sides of the rams, the colour of the upper parts is brownish red, tending in old rams to blackish, and passing into ashy grey on the head; the muzzle, a streak on the rump, the sides of the tail, the feet, portions of the

lower parts of the legs, and the under surface of the body being white. The horns, which vary in length from 20 to 34 or even 38 inches, curve forwards by the sides of the face in urial-fashion, but occasionally have the spiral reversed, so as to resemble in this respect those of Gmelin's sheep. Apparently the horns of the Corsican mouflon are of a more open type than those of the Sardinian race—for the sheep inhabiting the two islands are almost certainly distinct—and heads with this open type of horn also have the face paler than in Sardinian mouflon. It may also prove that ewes of the Corsican race always carry horns, those from Sardinia being, at least frequently, hornless.

Although reported to have occurred formerly in parts of Greece and the Balearic Isles, it is not certain that the mouflon was ever an inhabitant of these countries. At one time mouflon were extremely numerous in Corsica and Sardinia, accounts being extant of the slaughter of four hundred or five hundred head during a single hunt; but at the present day, except perhaps in the heart of Corsica, they are much less common, so that instead of being met with in large flocks, they are only seen in companies of from four to five up to seven, while in the largest "drives" not more than forty or fifty head are killed at one time.

In Sardinia mouflon, instead of being found on all the mountain ranges, are restricted to certain chains.



HEAD OF UNICORN RAM

HARMSWORTH NATURAL HISTORY

where they frequent only the highest ridges, generally confining themselves to such peaks as command a view of the surrounding country. The flocks of mouflon are led by an old and powerful ram, but at the pairing season these large flocks split up into small parties, consisting of one ram and several ewes. The rams engage in fierce conflicts among themselves for the supremacy, and during December and January the mountains re-echo with the sound of the blows as one ram rushes against the head of another.

The lambs—either one or two at a birth—are produced during April or May, and are able in a few days to follow their dams everywhere. Mr. E. N. Buxton, who states that Sardinian mouflon are extremely difficult animals to approach, observes that "when they are alarmed, or at 'gaze,' they have a habit, or at least the rams have, of placing themselves in the middle of a bush of macquia, or in the shadow which it casts. The ewes, which are naturally less conspicuous, do this in a less degree. The mouflon are assisted by the wonderful alertness of their eyes." Mr. Buxton also states that "one of their favourite devices is to seek for spots on the lee-side of a ridge where the currents of air meet. Here, in otherwise favourable positions, they are quite unapproachable." Occasionally wild mouflon will desert their own kin to live among tame sheep, while sometimes also a motherless domestic lamb has been known to seek companionship among a flock of mouflon.

DOMESTICATED SHEEP

Although, from the similarity in the form and structure of their horns, the domesticated breeds of sheep are allied to the mouflon, Gmelin's sheep, and the urial, there is great uncertainty as to their origin, and even whether they are derived from a single or from several original wild stocks. The most important features by which most domesticated sheep differ from their wild cousins are the length of the tail and the substitution of a coat of wool for one of hair. No wild sheep, except the Barbary, which has horns of a totally different type, is furnished with a long tail; but it has been suggested that the long tails of the domesticated breeds are due to a kind of degeneracy, and it is noteworthy that the Indian Hunia breed is reported to be naturally short-tailed.

Domesticated sheep vary greatly in the character of their horns. In the Dorset breed, for instance, these appendages are present in both sexes, in others only the males are provided with horns, while in yet other breeds, like the Southdown, horns are absent in both sexes. On the other hand, there is a tendency among some breeds to produce additional pairs of horns, so that there are four-horned, and even eight-horned, sheep. When there is more than one pair of horns, they arise from a peculiar elevated crest on the frontal bones. In the so-called Wallachian breed (page 665) the horns of the rams spring almost perpendicularly from the frontal bone, and then take an elegant, corkscrew-like spiral form. Still more remarkable are the horns of the so-called unicorn sheep of Nepal, in which those of the rams grow together to form

a large single horn. Remarkable variation is also displayed by the tail, which in the flat-tailed breeds may be either of immense length and thickness, or short and expanded into a fatty mass.

R. LYDEKKER

BRITISH DOMESTICATED SHEEP

Sheep have always played an important part in the history of agriculture. Although it has not served as a beast of burden like the ox, still it supplies practically everything in the form of clothing and food which man requires when in a primitive state. That it was associated with man in the pastoral stage we gather from early records, clearly showing its remarkable adaptability to stand various changes of climate, and to thrive under adverse conditions. Little seems to be known of the early ancestors of the present British breeds, or when the sheep first appeared in the British Isles. It is known, however, that British wool was held in high esteem, and a woollen manufactory flourished in England shortly after the advent of the Romans.

For many years sheep were cultivated almost entirely for their wool, and it was not till later, when the population of the United Kingdom increased, that the value of the carcase was recognised, and the fleece began to be sacrificed for the better production of

mutton. And it was only during the nineteenth century that, owing to the enhanced skill of breeders, the highest method of bringing wool and flesh to perfection was achieved. The quality of the wool, however, has in some respects deteriorated, and for the manufacture of the best classes of goods recourse is now had to merinos.

Another characteristic of the sheep which is of great service to the farmer is its power of improving and restoring fertility to land upon which it is fed. On sandy soils and poor, light land the value of sheep for this purpose cannot be overestimated. The old Spanish proverb, "The golden foot

of the sheep," refers to this fact. The treading of the small feet in consolidating light soils is also an advantage for the growth of the succeeding crops.

A word must be said with regard to the influence which the introduction of root crops into the ordinary systems of farming had on the sheep industry of the United Kingdom. Before the turnip and swede became common farm crops and helped to develop an intensive system of arable farming, there was little winter food for sheep, and consequently their growth was somewhat slow. Now, however, with improved breeds and bulky root crops for winter keep, sheep can be fed from birth till they are ready for the butcher without a check, and in much less time than formerly.

The breeds of sheep in the British Isles are best classified according to their fleece into long wools, short wools, and mountain breeds.

LONG WOOLS

LEICESTER. Owing to its history and to the fact that it has been made use of to improve several of the other breeds, this breed may be looked on as the most important race of English sheep. It was the breed which in 1755 Robert Bakewell, of Dishley, in



LEICESTER RAM

The photographs of British sheep on this and the subsequent pages have been supplied by Messrs. Vinton & Co.

LONG WOOLS

Leicestershire, started to improve by his methods of in-breeding and selection. The sheep he began with was a large-framed, slow-growing, coarse animal, with a heavy fleece of somewhat indifferent quality. This he converted by his special methods into a smaller, more symmetrical, and finer-boned sheep, with better fattening qualities. His principal aims were improvement of form and quality of flesh, combined with early maturity; and he treated the question of the fleece as quite a matter of secondary importance. The improved characters and more rapid feeding qualities of Bakewell's flock after a time attracted the notice of his neighbours, and shortly afterwards a demand sprang up for the use of rams of his breeding for improving the sheep stock in his own and other districts.

The modern type of Leicester shows the characteristics thus developed in a marked degree, and in consequence it has for many years been sought after by Continental and other breeders for purposes of crossing, although some other breeds, which owe their improvement to Leicester blood, such as the Lincoln, have become more popular, owing to the length and quality of their wool. The following are the special points of the breed: The head is small and fine, and slightly woolled on top; the face is white, with a slightly blue tinge, and the ears thin and long. The body is square in frame, with the fore quarters specially well developed; the hind quarters are, as a rule, not so full as they should be, and often form a weak point in the breed.

The bone should be fine, and, together with the fibre of the fleece, should show evidences of quality. There should be a marked tendency to fatten early, but this, unfortunately, is often combined with an undue laying on of fat, which deteriorates the quality of the mutton.

Bakewell's success in the improvement of the breed may be attributed to (1) extraordinary powers in judgment of form and quality; (2) his endeavours to obtain the best stock from all sources; (3) his system of breeding from closely related animals; and (4) the elimination of all animals not conforming to the type he was aiming at producing.

BORDER LEICESTER. This is a larger animal, stronger in the bone and more vigorous than the English type. There is little doubt that it originated from Bakewell's Leicester by crossing with North-country ewes. The head is long, and the face is covered with short, white hair, which extends well back behind the ears; the legs are also clean and white. The body is well set up, but presents a somewhat light appearance, owing to the length of leg. The wool, which is in

little locks, is lustrous and soft, although the fleece is sometimes too open. The breed is particularly found in Northumberland and on the Scottish border.

COTSWOLD. The Cotswold is a very ancient breed, whose home for generations has been the Cotswold Hills of Gloucestershire. It is specially noted for its style and graceful carriage, and the large tuft of wool on the forehead which hangs down almost to the nostrils. The ewes, however, gradually lose this tuft with age.

The head is well carried on an arched neck, and the face is either white or slightly mixed with grey, with legs to match. The body is long, level, and wide, with a broad, straight back well covered with firm flesh. The fleece should be composed of long, lustrous wool, and have a well-defined lock, showing a wavy curl. Rams are largely exported for purposes of crossing with other breeds.

LINCOLN. This is a very heavy sheep, competing with the Cotswold as the largest of British breeds. It has been improved in the

past by crossing the old Lincoln, noted for its length and quality of wool, with the English Leicester. The face is pure white, and the head is surmounted with a tuft of wool, though not quite so abundant as in the Cotswold.

In body it is a large, square-framed sheep, very deeply fleshed along the back, and well developed in the hind quarters. The wool is long, lustrous, strong in fibre, and of superior quality. The rams of this breed are very popular with foreign buyers for increasing the size and wool production of their flocks, and high prices have of recent years been made by Lincoln breeders for first-class rams.

ROMNEY MARSH, or KENT. This old and hardy breed has been associated for many years with the marsh land in the south of Kent, known as Romney Marsh. They are white-faced sheep with black noses, and a small tuft on the forehead. They are also characterised by the somewhat Roman-shaped nose and low, compact forms on short legs. In their native district they seem to be remarkably immune from foot-rot, which is such a curse to most breeds.

DEVON LONG WOOL. This is a local breed of Devon

and Cornwall, which has been greatly improved in recent years. The face is white, and the body is long and wide, producing a carcase of excellent mutton, and also a heavy fleece of good wool.

SOUTH DEVON LONG WOOL. Another local breed found in Devonshire, the South Devon long wool, lays claim to great antiquity. It is noted for its production of mutton and wool, and differs from the Devon



COTSWOLD RAM



LINCOLN RAM

HARMSWORTH NATURAL HISTORY

long wool in being somewhat larger and clipping a heavier fleece. The face and legs are white.

WENSLEYDALE. This large, high-standing sheep is found principally in Yorkshire, and sometimes spoken of as the Yorkshire Leicester. The breed is easily recognised by its style of carriage, and by the head, which has a greyish blue face and small forelock. The wool also is of special character, being open and long, and



ROMNEY MARSH RAM

divided into little "pirls." The rams are in favour for purposes of crossing with other breeds. Thus, when a Wensleydale is mated with blackface Highland ewes, it gives rise to the popular cross known as "Mashams."

ROSCOMMON. A large, white-faced Irish breed, found principally in Connaught, the Roscommon approaches the Cotswold or Lincoln in size. These sheep produce fine carcasses of mutton, and the fleece is long, heavy, and silky. The breed has been improved by selection and by crossing with the Leicester.

SHORT WOOLS

SOUTHDOWN. The Southdown holds a similar position among the short wools to that held by the Leicester among the long wools; and the early type was improved and brought to its present standard of excellence largely owing to the efforts of John Ellman, of Sussex (1753-1832), who worked on Bakewell's lines. It cannot, however, be looked upon as a farmer's rent-paying sheep, except in its native district in the South of England, owing to the small weight of its carcass and the light clip of wool.

The head is fine, but wide between the eyes; and the face is full, and of an even mouse-colour. The body is compact and deep, on short legs, and so symmetrical that it gives its owner the appearance of being the most graceful of all the native English breeds. The flesh is well let down on to the hock, and the twist is well developed, thus forming a good leg of mutton. The fleece is close, even, and short, and the wool of the finest quality of all the Down breeds. The skin should be of a clear, bright pink, and the whole appearance and carriage of the sheep should be such as to fascinate and engage the attention of the observer.

HAMPSHIRE DOWN. This breed is said to have originated by crossing the old Wiltshire horned sheep and the "Berkshire Knot" with the Southdown. The head is large, with a strongly marked Roman nose, the faces and legs being of a very dark brown or black. The body is long and deep, with well-sprung ribs. A slackness behind the shoulder was at one time a defect, but this has been largely got rid of. The fleece is fine

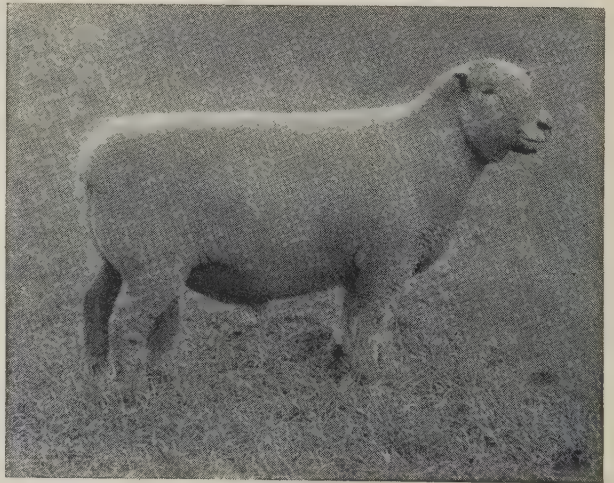
and close, coming well up on to the head and round the ears. The early-maturing properties of this breed have been greatly developed, and the ewes come in season sooner than most other breeds. On this account, also, the lambing season begins early; that is, soon after Christmas.

DORSET DOWN, or WEST COUNTY DOWN. This breed may be looked on as an offshoot of the Hampshire Down breed, which has been specially developed in Dorsetshire with the aid of Southdown blood. The breed is sometimes spoken of as the "improved Hampshire."

SHROPSHIRE DOWN. This is a medium-sized sheep, very similar in appearance to the Southdown; but the head is more massive, and almost entirely covered with wool, which comes on to the cheeks and right up round the eyes. The nose, which is the only part of the face exposed, is of a blackish brown colour. The breed originated from a cross between an old Shropshire breed known as the "Morfe Common" and the Southdown. It is hardy in constitution, feeds quickly, laying on a good covering of flesh on the valuable parts, and is very accommodating as to changes of soil and climate. It also grows a heavy fleece of first-rate quality, the wool being fine and close set. For these reasons it has become very popular, not only in Great Britain, but also in other countries, and the rams are much used for crossing purposes with other breeds.

SUFFOLK DOWN. This variety was the outcome of a cross between the old Norfolk horned sheep and the Southdown. Its head is very characteristic, being hornless and bare in appearance, the face being covered with fine coal-black hair, which extends well back behind the ears. It possesses a square frame, well covered with firm flesh. Its legs are clean and straight, black in colour, with fine flat bone. The points of the breed are wealth of constitution, early maturity, a fine close fleece, and excellent quality of mutton.

DORSET AND SOMERSET HORNED. This is a very old white-faced horned breed found in Somerset,



SOUTHDOWN RAM

Dorset, and the western counties. The horns are characteristically curled, and the nostrils are pink. The ewes are noted for their fertility, and can be bred from twice in the year; but this is not often done, owing to the weakening effect it has on the constitution. The usual lambing time is October and November.

RYELAND. This local breed, of ancient origin, is found in the "Ryelands" of Herefordshire, and nearly

MOUNTAIN BREEDS

disappeared a few years ago. The head has a white face surmounted by a top-knot, and the legs are also white. They are small-sized, compact sheep, with a vigorous constitution and a short fleece of exceptionally fine wool. The rams are often used for purposes of crossing.

OXFORD DOWN. This breed was formed by a cross between the Cotswold and the Hampshire, with the object of combining the weight of carcase and length of fleece of the former with the quality of mutton and fine wool of the latter. It is now in much favour in the English midlands as the farmer's rent-paying sheep, and is well thought of by butchers. In fact, in some places it has ousted the original sheep of the district as a general-utility animal. The head is large, with the wool forming a top-knot and coming well on to the face, which is of a brown colour. The body is deep and long, and well fleshed. The fleece is heavier than in the other Down breeds, and the mutton is of good quality and not too fat.

MOUNTAIN BREEDS

CHEVIOT. The Cheviot holds an important place among mountain breeds. It is very hardy, and can adapt itself to changes of climate, so that when brought down from higher elevations it fattens rapidly on lowland farms. It is easy to recognise by its nose of Roman type, and face covered with short, white hair, which is carried back well behind the ears; its small and compact body is set on short legs of a white colour, and terminated by a long and well-hung tail. The wool is straight, and of moderate length, well covering the body. It crosses excellently with the Wensleydale or Border Leicester, producing the famous "half-breds" or "white-faces."

SCOTCH BLACKFACE. An even hardier breed than the Cheviot, the Scotch blackface thrives on poor and exposed pastures at very high elevations. It is the typical hill sheep of Scotland, and is kept in enormous flocks on the high-lying sheep farms. Both sexes are horned, and the face and legs are mottled, showing black and white in well defined patches. The fleece is long, strong, and coarse in texture, and consequently fetches a lower price than the finer wools; but there is a



HAMPSHIRE DOWN RAM

good demand for it in America. As might be expected, the breed is slow in coming to maturity, but the mutton, when grown, is of the finest quality.

HERDWICK. A local breed found on the hills of Cumberland and Westmoreland, the herdwick possesses a great wealth of constitution. An old legend states that they are the descendants of some sheep saved from

the wreck of a galleon which formed part of the Spanish Armada. The face and legs of the lambs are generally of a darker colour when dropped, but gradually change to white or steel grey. The wool is strong and coarse, like that of other mountain breeds. The rams are sometimes horned. A peculiarity of the breed is that animals are sometimes found with an additional or fourteenth rib.

LIMESTONE. This is another local breed, found



SUFFOLK RAM

on the limestone hills in parts of Westmoreland and Derbyshire. Both rams and ewes are horned, and the faces and legs are white. The wool is also white, and very long, and the mutton is of good quality. It is hardy and prolific, and it is possible to breed fat lambs for Christmas.

LONK. The lonk has its home on the hills of West Yorkshire, Lancashire, and Derbyshire. It is very much like the blackface in appearance, but is larger, and the fleece is shorter, finer, closer, and heavier, and the constitution is not so hardy. It is a horned breed with a long, rough tail, and the face and legs are black or mottled.

EXMOOR. This is a small horned breed somewhat like the Dorset horned in appearance, but stronger in constitution. It is found in parts of Cornwall and Devonshire. The faces are white, with black nostrils, and the mutton is of first-rate quality.

DARTMOOR. The Dartmoor, another breed found in Devonshire, is hornless, of medium size, and very hardy. The face and legs are speckled, and it possesses a good fleece of soft, long, curly wool.

WELSH MOUNTAIN. This small, hardy, long-tailed breed is found on the hills throughout the Principality. The rams have gracefully curved horns, but the ewes are generally hornless, and the face and legs are white in colour. It has a great reputation for producing small juicy carcasses of mutton, which are highly prized on the London market. On the Welsh hills the original small breed exists, but in the lowlands its character has been somewhat altered, and its size increased by crossing with early-maturing breeds.

KERRY HILL. This may be looked on as the most important of a number of local Welsh breeds which have recently come to the front. It is hornless, with a speckled or mottled face and legs and compact body. It produces a good fleece of fine wool, and carries its tail long.

RADNOR, OR TANFACE. This is an old Welsh mountain breed from Radnorshire. They are short-legged, hardy little sheep, with long tails, and produce a close fleece of fine wool. The faces and legs are speckled.

HARMSWORTH NATURAL HISTORY

The ewes cross well with Shropshire, Hampshire, and Oxford rams for the production of early lamb.

CLUN FOREST. This breed originated by crossing an old, tan-faced, native Welsh variety from the Clun district with the Shropshire. The head is small, and the face is black to a fawn colour; the horns are going out, but the sheep retain their long tails. The mutton is of excellent quality, and sold as "Welsh" on the London market. It is often crossed with rams of the early-maturing breeds for purposes of getting fat lambs.

PENISTONE. This long-tailed breed is very similar to the limestone, and is found on the borders of Yorkshire, Lancashire, and Derbyshire, in the neighbourhood of Penistone. The faces and legs are white or light grey, and horns are generally present. The fleece is of medium length, silky in appearance, but somewhat inclined to be coarse in quality.

GENERAL MANAGEMENT

Various systems of sheep farming are followed in different parts of the United Kingdom, the methods adopted depending on the soil and climate, and the special objects the farmer has in view. Thus, in the more mountainous districts in the north and west the "hill-breeding flocks" are found, wool being the chief consideration. On chalk downs where there is plenty of room, lamb breeding is often indulged in, the lambs being sold at the autumn fairs.

On arable farms which will carry sheep the "permanent flock" is the general practice. In this case it is usual to breed, rear, and fatten on the same farm, forcing on the lambs for sale as rams, or for purposes of turning them into mutton. Should the latter be the object, the tews are fattened off on roots during winter.

In the case of grass farms in the vales, where the land is good, the "flying flock" is the usual custom, any sort of ewes being bought in the autumn to breed one crop of lambs. The ewes and lambs are then sold off fat at Easter or soon afterwards. It may here be noted that one of the principal factors of success in sheep farming is to obtain the services of a good shepherd who can be depended upon at all times,

season is the most anxious time of the year to the sheep farmer, as on the crop of lambs obtained depend the year's profits. It should be remembered that parturition is a natural process, and that it is a great mistake, in the anxiety to take every precaution, to over pamper the ewes or to handle them unnecessarily.

The feeding and treatment after lambing should be such as to give the ewe's milking powers full scope. The best foods for this purpose are a few roots, such as turnips, swedes, mangel, or a little cabbage, together with clover, hay, and a small allowance of a mixture of oats and cake. Lambs are very hardy, and when they have plenty of milk, after a few weeks' shelter about the pen they may be sent with their mothers to another part of the farm.

WEANING. Lambs may be weaned when from three to four months old. The exact treatment of ewes and lambs before and after weaning will depend very largely on the resources of the farm, and the object for which the lambs are intended. On arable farms, while with their mothers, the lambs should be encouraged to run forward through creeps to nibble the young shoots of turnips, and to eat a little mixture of oats, split peas, and linseed-cake. Thus, when weaning takes place they will be already accustomed to feed by themselves, and the separation will affect them but little.

After weaning, lambs should be put on good pasture or seeds, and have a small allowance of corn. Ewes should, on the other hand, be run on poor grass to get rid of their milk. Lambs intended for the butcher must be forced along all the time, and are generally



CHEVIOT RAM



DORSET HORNED RAM

Photo, W. Pouncy

and whose sympathies are bound up in the interests of his flock. The chief points in the management of a flock may be dealt with under the following headings:

LAMBING. Lambing takes place earlier in the southern counties of England than in the north, where the climate is less genial. The site for the lambing-pen should be chosen with care, and dry, sound ground, with a southern aspect, is essential. The lambing

fattened off as tews on roots during the winter, receiving at the same time an allowance of artificial food. Ewe lambs to be kept on for breeding purposes need only be run over the winter in healthy store condition.

WASHING. This is done in May or early June, about a week or ten days before clipping. The object is to clean the sheep by removing accumulations of dirt, and thus make the wool bright. There is some difference of opinion among flockmasters as to the advisability of washing their sheep, owing to the damage that is sometimes done to them; but as washed wool is worth considerably more per pound than unwashed the process is usually carried out on most farms.

SHEARING AND CLIPPING. The operation of shearing and clipping follows about a week or so after washing. The time for this operation varies according to the climate, beginning in May in the south of England, and later as we go northwards. The tews are generally shorn first, the ewes following a week or two afterwards.

STATISTICS OF BRITISH SHEEP

DIPPING. The value of dipping is now fully recognised by farmers, and is carried out with the object of preventing parasitic attacks on sheep, such as the fly, ticks, and scab. Dipping is at the present time compulsory, and has to be performed at least once during the summer. Better results are obtained, however, if the sheep are dipped a second time towards the autumn. A dip may be made at home, but it is generally more convenient to purchase a "patent dip." To carry out the operation a bath of some sort, either portable or fixed, must be made use of.

CULLING AND SELLING SURPLUS STOCK. Towards the latter part of the summer it is the custom to go through the breeding stock to decide which animals shall be drafted and got rid of. The age at which a ewe is drafted will depend on her general soundness, good points, and the condition of her teeth. Draft ewes intended for the butcher must be pushed on as rapidly as possible, and they should receive extra food in the shape of cake and corn.

WOOL

If wool be examined under the microscope it will be found to be composed of a great number of very



SCOTCH BLACKFACE RAM

Photo C. Reid

fine wool hairs or fibres. If these fine fibres are examined more closely it will be seen that they are covered with a series of small scales all pointing in one direction. It is owing to these small scales catching together that the fibres become felted into a strong piece of cloth when the wool is spun and weaved. The crimp or natural waves in the wool make it possible to twist the wool into yarn, and the scales assist the wool fibres to felt.

The value of a fleece will depend on its quantity, quality, and condition. In examining a fleece the best wool will be found over the shoulder in the region of the heart; the coarsest wool, on the other hand, is situated on the thigh. The fleece should, therefore, be opened and inspected in these two places when judging its value. Wool may be divided generally for market purposes into the following classes:

CARDING WOOLS. These are short-stapled wools, used principally in the manufacture of clothing and woollen goods. The Down wools, especially the Southdown, are good examples of this class.

COMBING WOOLS. These are long-stapled wools used for the production of worsteds. Lincoln, Cotswold, and other long-stapled wools belong to this class.

CARPET AND KNITTING WOOLS. These are long-stapled wools, coarse in fibre, such as that grown by the Scotch blackface.

These classes may be again divided into various grades according to the size or fineness of fibre. The quality of the wool will be determined by its softness, fineness of fibre, and soundness. As a rule, short-woolled sheep produce the finest quality of wool.

STATISTICS OF BRITISH SHEEP

In concluding this account of the British domesticated breeds of sheep and their management, it will



WELSH MOUNTAIN RAM

be of interest to examine the following figures showing the number of sheep kept in the United Kingdom and also the value of the imports and exports of sheep and their products. The important part sheep farming plays in the economy of the British Isles will then be more apparent.

According to the returns of the Board of Agriculture, the following was the analysed sheep-stock of the United Kingdom for 1908:

Ewes kept for breeding	..	..	12,241,317
Other sheep	..	..	19,091,083

31,332,400

This represents a capital value of some £50,000,000 sterling. These figures show an increase of $4\frac{1}{2}$ per cent. over the stock of 1907.

In 1907, also, 105,601 live sheep were imported for home consumption, together with 4,617,743 cwts. of mutton, the total value of these imports being some £9,000,000 sterling.

Referring to the prospects of the wool trade, it may be said that during the period of agricultural prosperity of the nineteenth century wool was one of the most remunerative products of the farm, and in some of the sheep-farming districts farmers used to look to the clip of wool to pay the rent for the year. The price of wool, however, afterwards declined, and towards the end of the century it reached its lowest ebb, being then only worth from 7d. to 8d. per pound. The first years of the twentieth century have shown an improvement, although the price is still liable to mercurial fluctuations.

The great difference a rise in the price of wool makes to the income of the farmer may be readily realised when we remember that some of the larger breeds clip 8 to 10 pounds or more per fleece, and estimate what this increased value means to the owner of a large flock when there is a rise of 4d. or 5d. per pound.

In reference to mutton, the improvements in the sheep of Australia and New Zealand as regards carcase, assisted by increased facilities in respect of transport

and cold storage, have been the means of opening up a large trade in frozen meat, and enormous quantities of mutton are imported into the United Kingdom annually in this way. A dead-meat trade in mutton has also sprung up with the Continent, the sheep being slaughtered at the seaports and at once shipped across to England.

The above causes all tend to keep down the price of mutton, but fluctuations in value are continually taking place owing to causes which it is difficult to define.

Although large quantities of mutton come into the United Kingdom from the British colonies and foreign countries, it must be remembered that the flock-masters across the seas are largely dependent, in keeping up the quality of their stock, on fresh blood obtained from Great Britain. There is an increasing demand, therefore, for rams from the British strains, and English breeders will always have the monopoly of this remunerative export trade provided they maintain the reputation of their flocks.

In addition to the returns obtained by the sale of wool and mutton, and also of breeding animals from pedigree flocks, the great value of sheep for improving the land they are fed on must again be mentioned. In fact, there is a good deal of poor, hilly land in the British Isles which it would be almost impossible to farm profitably without the aid of sheep. A flock maintained on such soils, besides obtaining a living for themselves, are a cheap means of manuring and keeping up the fertility of the land, which would otherwise entail an enormous cost in labour and manure for cultivating. Sheep act a similar part on all light arable farms. The sheep must, in fact, be looked on as an indispensable animal for farming most of the land in the United Kingdom.

DRYSDALE TURNER

FOREIGN BREEDS

In Africa there are several types of sheep bearing hair in place of wool; one of these being the long-legged sheep of Guinea, which, on the assumption that it is specifically distinct from the European breeds, although that is by no means certain, has been named *Ovis longipes*. The coat, which is short and glossy, is usually foxy red in colour; and while in Guinea the rams carry small horns, in the breed which has been introduced into the Barbadoes both sexes are hornless.

The Hausa sheep of Nigeria (*O. l. carnapii*) is another breed of the same type, in which the rams carry long, corkscrew-like horns directed straight outwards, while both sexes have a pair of lappets, or wattles, on the throat, long, pendent ears, and convex profiles. The colour is black and white, and in winter the coat becomes quite long and shaggy, although it is short in summer.

The maned sheep (*O. jubata*) has a long, rough coat in winter, with a mane on the throat and neck, comparatively short legs, and the colour either brown or piebald. In the Abyssinian breed of this sheep the horns of the ram extend outwards, much in the same fashion as in the Hausa sheep, but in the small Cameruns breed, which is not larger than a fox, the horns are quite small and curly, the colour being reddish brown, with black on the mane and limbs.

Another noteworthy African breed is the Zulu piebald sheep, in which there are frequently four horns, in some cases in both sexes.

These sheep in Africa have short hairy coats, but in the breed introduced into England the coat has become woolly. An allied or identical breed occurs in Syria.

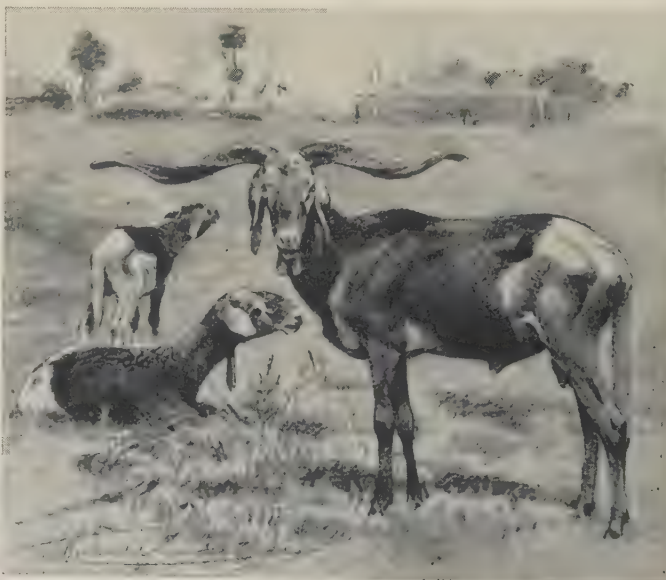
The Hunia sheep of India, the rams of which are used for fighting, is remarkable for having a short, conical tail, the profile being very convex in the rams, and the horns often large and spiral. The coat is white and woolly. From the occurrence of this short-tailed sheep in India, it seems not improbable that the urial may have had a share in the production of the domesticated breeds.

A still more remarkable type is presented by the unicorn sheep of Nepal, in which, as already mentioned, the horns of the rams unite together, and curve backwards in such a manner that, unless sawn off, the tip would penetrate the back of the animal (page 657). The ewes, on the other hand, have quite small horns of ordinary type on the sides of the head.

In marked contrast to the conjoint horns of the unicorn breed are the long, spirally twisted horns of the Wallachian sheep, which are three feet in length, and in the typical breed extend upwards and outwards at an angle of about 45 degrees, although in the breed kept in Hungary they are more upright. These sheep,



CAPE FAT-TAILED SHEEP



HAUSA SHEEP

THE BHARAL

which are known in Germany as the *Zaëkelschaf*, have been described as a species under the name of *Ovis strepsiceros*: the horns of the rams recall those of the Suliman race of the Markhor wild goat (page 676).

All the foregoing breeds have the tail cylindrical, but in the fat-tailed and fat-rumped sheep of Africa and Asia this appendage becomes flattened. Fat-tailed sheep are common to several Eastern countries, such as Persia and Africa, but the maximum tail-development occurs in Cape Colony, where the tail may be more than a yard in length and particularly thick at the base, so that its weight may be several pounds. The colour of the wool is generally white, but often with blotches of black or brown.

Very different from the fat-tailed breeds are the fat-rumped sheep (*O. steatopyga*). In these sheep, which are found in the countries to the east of the Caspian Sea, such as Persia and many parts of Central Asia, as well as in north-eastern Central Africa, the flat tail becomes short or rudimentary, and the fat accumulates on either side of the haunches in two great protuberances, whence the name *O. steatopyga*.

This breed is of large size, and differs from European domesticated sheep in its completely hairy coat, which in the adult resembles very closely that of many wild sheep, generally consisting of short and close hair, and yielding no wool capable of being spun or woven. The lambs have, however, a perfectly woolly coat; and Dr. W. T. Blanford states that in Abyssinia the fat-rumped sheep kept in the highlands differ from the ordinary breed in being covered with wool. They have also frequently well-developed and handsomely curled horns.

In the Sudani hairy breed of these sheep the hair is white on the body, but black on the head and front part of the neck; the horns being small and curly.

THE BHARAL

The bharal, or blue sheep of Tibet (*Ovis nakuru*), is the first of two wild species differing markedly from all the rest in the characters of their horns and skulls, and approximating in these respects to goats. As regards the horns, the male bharal has these appendages nearly smooth, and rounded or sub-quadrangular at the base, while their curvature assimilates more to a letter S than to the spiral characteristics of the typical sheep. They are marked with fine transverse *striæ*, and rise very close together on the head; their direction being outwards, at first upwards, then downwards, and at the extremities backwards. The ewes have short horns, curving upwards and outwards. There is no gland on the face, and consequently no pit in the skull below the eye. The tail is relatively longer than in any of the wild species yet

noticed. The coat is of uniform length throughout without any trace of a mane on the neck or fringe on the throat, and remarkable for its smoothness and compactness.

As regards colour, the adult male bharal is a decidedly striking animal, the general tint of the upper parts being brownish grey, becoming more distinctly brown in summer and tending to slatey grey in winter, while the under parts, the insides and backs of the limbs,

as well as the rump as far as the root of the tail, are white. The front of the face, the chest, a stripe down the front of the limbs, interrupted by white at the knees, and another along the side dividing the white of the belly from the dark of the upper parts, as well as the last two-thirds of the tail, are black. The black markings on the face, chest, and flanks are wanting in the ewes.

The ram stands about 3 feet in height at the withers, and good-sized horns have a length of 24 or 26 inches along the curve, with a basal girth of some 11 inches. Specimens have, however, been recorded measuring 30½ and 32 inches in length, and 13 inches in

girth. The ewe is considerably smaller.

The bharal is essentially a Tibetan species, ranging from near Shigar in Baltistan and the neighbourhood of Sanju, south-east of Yarkand, as far eastwards as Moupin in the Sze-chuen province of China; while in a northern and southern direction it embraces the area lying between the main axis of the Himalaya—or a few of the higher ranges to the south—and the Kuen-Lun and Altyn Tagh ranges.

Structurally, the bharal is as much a goat as a sheep, but in the absence of a beard and of a strong odour in the rams, as well as in appearance, it is more like a sheep, and is consequently placed in that genus.

It exhibits, however, a marked difference from other species of the same general size in refusing to breed with domesticated sheep; and its relationship to the goats is so strong that, were it not for convenience, there are considerable grounds for including both sheep and goats in a single genus.

In conformity with its structure, the bharal is intermediate in its habits between typical sheep and goats. Like the former, it is found on undulating ground, and

frequently lies down during the day on its feeding ground, though generally among stones; but, like the latter, it is a splendid climber, perfectly at home on precipitous cliffs, and wont, when alarmed, to take refuge in ground inaccessible to man. It is found in flocks of from eight or ten to fifty or even a hundred, the males and females feeding apart in the summer, but frequently associating at all seasons. The flocks keep to high open ground above forest, and never enter bush.



ABYSSINIAN MANED SHEEP



WALLACHIAN SHEEP

Bharal feed and rest alternately during the day; and, owing to their colour (page 627), it is peculiarly difficult to make them out when they are lying down amongst stones. It appears that these sheep are never found below an elevation of 10,000 feet above the sea-level, and in summer range up to 14 and 16 thousand feet. Bharal are by no means difficult to approach in districts where they have not been much disturbed.

THE UDAD, OR BARBARY SHEEP

The udad, or Barbary sheep (*Ovis lervia*, or *O. tragelaphus*), which is the only wild representative of the group met with in Africa, while approximating to the bharal in the characters of its horns and skull, is distinguished by the great mass of long hair clothing the throat, chest, and fore limbs, and likewise by the length of the thickly haired tail, which reaches slightly below the hocks. By the inhabitants of its native country this sheep is generally known as the arui.

The Barbary sheep attains a height of rather over 3 feet, and is of a nearly uniform deep rufous yellow colour, with the individual hairs differently coloured in different parts of their lengths. The females are distinguished from the males by the much shorter hair on the fore quarters, but have horns nearly or quite as long. The horns do not generally exceed 25 inches in length, but may reach 26 inches or a little more; and, although finely wrinkled in the young, are nearly smooth in the adult.

These sheep, generally found alone or in parties of two or three, are sparsely distributed over the more precipitous regions of the arid southern slopes of the Atlas range, from the Atlantic to Tunis. They are unknown in the interior of the range near the coast, always keeping within sight of the desert, and capable, according to Arab reports, of going several days without water. Their colour harmonises admirably with the limestone rocks of their native mountains.

The Arabs are in the habit of pitching their tents near the scanty springs frequented by these sheep, and daily lead their goats high up the mountains. consequently, the arui, writes Mr. E. N. Buxton, have "no means of escaping from them, as every mountain within reach of water is similarly infested. They are constantly within sight and hearing of the Arabs and their goats, and as they cannot get away they have developed the art of hiding themselves to an extraordinary extent, and they have unlimited confidence in their own invisibility.

This was demonstrated by me one evening when I sat for twenty minutes carefully spying the surrounding country. The knoll on which I sat commanded a small shallow hollow. In this there was not a vestige of cover except a few thin thuya bushes which looked as if they could not hide a rat. It was not till I rose to shift my position that a female arui and two yearlings started from these bushes. They had been lying within sixty yards of me, and must have been fully conscious of my presence all the time. The arui, in this habit of hiding, is very like

the Pyrenean ibex, which lives in rather similar ground, and also trusts to concealment in preference to flight."

GOATS

The two preceding species of sheep connect the more typical representatives of that group so intimately with the goats that there is some difficulty in drawing up a list of characters which will satisfactorily distinguish between the two. The males of all the goats are, however, characterised by the possession of a peculiar strong odour, while they generally have a beard on the chin. None has any gland on the face below the eye—in which respect they resemble the bharal and Barbary sheep; and they differ from all the sheep in the absence of any glands between the hoofs of the hind feet, while in some cases, at any rate, these glands are likewise wanting in the fore feet. In all the species the tail is short, and there are peculiar hard patches, or callosities, on the knees, and in some instances also on the chest.

The skull of a goat differs from that of a sheep in that the plane of the portion behind the horns meets that of the part in front in an obtuse instead of a right angle, while the profile of the face is



UDAD, OR BARBARY SHEEP

WILD GOATS

very concave, and the occipital region rounded instead of nearly flat. The more typical goats, or those constituting the genus *Capra*, are further distinguished by the great length of the horns of the males. These are situated close together immediately above the eyes, and are continued upwards at first in the plane of the forehead; they may be either scimitar-shaped, with a backward sweep, or spiral, and are more or less compressed and angulated, while they are frequently ornamented with knobs or knots in front. In the females the horns are much smaller, and set farther apart at their bases.

Although the term goat is applied to one American ruminant, yet goats in the proper sense of the word are exclusively restricted to the Old World, where they are mainly confined to Europe and Asia north of the southern flanks of the Himalayas. It is true, indeed, that one species occurs in Egypt and another in Abyssinia, but the group is unknown in the whole of the remainder of Africa, while the species inhabiting the mountains of Southern India is classed in a genus apart from that containing the true goats. There are about ten species of true wild goats, all of which live in herds, although the males sometimes keep apart from the females, and are occasionally solitary.

Like sheep, goats are essentially mountain animals, but inhabit more rugged and more precipitous ground than do the majority of the former; this is, however, not invariably the case, as the Asiatic ibex ranges on to the open country of the Pamirs. All the members of the group are very active and wary, and are characterised by their tendency to browse on the young shoots and leaves of such trees and shrubs as they can reach, whereas sheep mainly confine themselves to grazing.

Geologically, goats appear to be somewhat older than sheep, remains of certain species having been obtained from the Pliocene rocks of the Siwalik Hills in Northern India, while those of others occur in the superficial deposits of the plains of Central Europe. The latter belong to a species of ibex, which is a matter of some interest as showing that during a colder epoch these ruminants could exist in the lowlands, whence, with an increase of the temperature, they migrated to the various mountain chains, where they have differentiated into distinct species from isolation. This probably explains the occurrence of allied species of wild goats in the Caucasus and the Pyrenees, and in the Alps and the Sinaitic Peninsula.

TUR

In addition to the typical wild goat, the Caucasus range is the home of two peculiar species of wild goats, locally known as tur, which, as being those approaching most nearly to the sheep, naturally come first. The tur inhabiting the eastern Caucasus, which may be distinguished as the eastern tur (*Capra cylindricornis*), is found to the west of Kasbeg and throughout Daghestan. It may be described as a goat with horns like those of the bharal, these horns being almost black, smooth, and nearly cylindrical, directed outwards and backwards in a somewhat spiral manner,

with their tips directed inwards, and sometimes not separated from one another by an interval of more than a foot. The general colour of the animal is light brown, and the height at the shoulder about 3 feet. The reddish brown beard is short, crisp, and curved inwards towards the middle of the chin. Another distinctive feature is to be found in the lower incisor teeth, which have very narrow crowns. Good specimens of the horns may measure about 35 inches along the curve, but specimens occasionally reach as much as 44 inches.



EAST CAUCASIAN TUR

A very different animal from the preceding is the West Caucasian tur (*C. caucasica*), which inhabits the western half of the main chain. The horns, especially in half-grown rams, are very like those of ibex, although with less prominent knobs. In their summer dress the old bucks are uniformly foxy red in colour, with the chin, beard, and lower part of the legs black. About 37½ inches is the usual height of this very handsome goat. Good horns range from 35 to 40 inches in length. In summer the coat is quite short and sleek, but the

winter dress is longer and rougher.

Ture, according to Dr. N. Dinnik, frequent the high central ranges of the Caucasus—but not, as a rule, the highest peaks—glaciers, and snowfields, and when found in such situations it is owing to their having been driven upwards by the neighbourhood of flocks and shepherds. In the North-Western Caucasus, where they are little molested, they are found at elevations between 7,500 feet and 8,000 feet, whereas the higher peaks are as much as from 10,000 feet to 10,500 feet above sea-level. In autumn they descend from these upland pastures, and in winter inhabit a level about a thousand feet below their summer resorts.

In summer they start at evening for their feeding grounds, moving off in undisturbed localities about an hour before sunset, but when molested deferring their march till the sun has set. They remain on these feeding grounds till about 8 or 9 a.m., when they begin to move off to higher elevations, where they pass much of their time in repose, sentinels being posted to give notice of approaching danger.

Sight and hearing appear to be keenly developed in these goats. The pairing season, when the bucks fight fiercely, takes place in winter, and the period of gestation is believed to be five months. Up to a comparatively recent date the native hunters were armed only with muzzle-loading flint-locks, with which they did little execution, but now many of them have weapons of a more modern type, and, except on strictly preserved estates, are rapidly thinning the game.

THE SPANISH WILD GOAT

Although often termed an ibex, the Spanish wild goat (*Capra pyrenaica*)—the “cabramontes” of the Spaniards—is much more nearly allied to the eastern tur. It is characterised by the horns of the males having an upward and outward direction, and forming a slight and very open spiral. They are flattened on the inner side and keeled behind, so as to present a pyriform cross-section. When seen from the front, their

form is somewhat lyrate, and on their outer sides they carry more or less well-marked bosses or knobs, resembling those on the front of the horns of ibex. There is a small but thick black beard, which may be of some length.

The general colour of the hair is light brown, but it is much darker around the nose and on the forehead and the back of the head; a triangular patch on the back, a streak on the flanks, and the front of the limbs are black; the upper lips, the cheeks, the sides of the throat, and the hind surfaces of the legs are greyish, and the remainder of the under parts white. There is, however, considerable variation in colour according to the season, and also a certain amount of local variation in this respect. The coat is much longer in winter than in summer, and there is a thick, woolly under fur. The height of the animal is about 26 inches at the shoulder. Horns of old rams average 24 or 25 inches, but may reach 30 or 31 inches in length.

The Spanish wild goat inhabits the Pyrenees, some of the mountains of Central Spain, and the higher ranges of Andalusia and Portugal. That the species has existed in the southern portion of its habitat since

complete transition from this type to the Pyrenean form. During the greater portion of the year the males of the Spanish wild goat live apart from the females, and it is only during the breeding season that the two sexes come together. Both sexes associate in flocks, which may be very large, comprising at times from a hundred to a hundred and fifty head. As a rule, the old bucks, heedless of snow and cold, reside on the most exposed and highest peaks of the mountains; but the does, especially in the late spring, frequent the southern slopes, and in the depth of the winter descend even to the neighbourhood of the villages. When feeding or reposing, sentinels are posted in commanding positions to apprise the flock of approaching danger, which they do by means of a loud snort, upon which the whole company at once takes to flight.

These goats are generally found among thick scrub, and it has been suggested that the incurving tips of their horns are formed on purpose to permit of easy passage among bushes. The pairing season is in November, when the flocks of opposite sexes come together, and the males engage in combats for possession of the females. In December the sexes again split up into separate flocks, the males from one to three years of age consorting, however, with the females.

The kids are born in April or the beginning of May, and in a few hours after birth are able to follow their mothers over the roughest ground. While the kids are young the mothers confine themselves to the southern slopes and warmer parts of the mountains, and carefully avoid such situations as are exposed to cold and cutting winds. These goats are hunted either by stalking or driving, and in either case display the extreme wariness characteristic of the group.

That the Spanish wild goat is allied to the East Caucasian tur is quite evident. The form and curvature of its horns, together with the presence of a keel on their posterior border, is, however, suggestive of a transition from the type of horn obtaining in the ibex to that found in the markhor, and it is thus easy to see how all the varieties of horns found among the goats may have been derived from a single common form.

THE WILD GOAT

The typical wild goat (*Capra hircus ægagrus*), the "pasang"—"rock-footed"—of the Persians, is a species of particular interest as being the chief ancestral stock from which the various breeds of domesticated goats are derived. This species is characterised by the long, scimitar-like horns of the males, which are much compressed, with the front edge forming a sharp keel, marked by irregular prominences and notches, while the hind edge is rounded, and the outer side more convex than the inner. Generally the tips of the horns are inclined inwards, although they are occasionally divergent. The horns of the does are much smaller, with an even front edge. The male pasang has a small beard, and in winter the hair on the neck and shoulders is rather longer than elsewhere, while at the same season in the colder portions of its habitat a coat of woolly under fur is developed beneath the hair.

In winter the colour of the upper parts is brownish grey, but in summer it tends to yellowish or rufous brown; the under parts and the inner sides of the buttocks being whitish or white. In the older bucks, however, the colour is paler; a stripe down the back, another on the shoulder somewhat in the form of a collar, the tail, chin, throat, and beard, the front of the fore legs, with the exception of the knees, and a stripe along the flanks are dark brown. There is



SPANISH WILD GOATS

the Pleistocene epoch is proved by the occurrence of its bones in the caves of Gibraltar, in company with those of an extinct rhinoceros.

It was at one time considered that the wild goat of Andalusia was specifically distinct from the Pyrenean form, but it is now known that the two are only local races of a single species. The race inhabiting the Pyrenees is the larger, and characterised by the horns of very old males tending to assume a smooth form, without distinct knobs, and thus approximating to those of the Caucasian tur. In specimens obtained from the Sierra Nevada, in Andalusia, at elevations of about eleven thousand feet, the horns are frequently as long as those of the Pyrenean variety, but are generally more flattened, while the size of the animals themselves is less. The wild goats of the Central Spanish Cordilleras are those with the heaviest and most distinctly knobbed horns, but there is a

DOMESTICATED GOATS

also a certain amount of white on the lower part of the legs.

Adult males stand about 37 inches at the withers. Good horns of the pasang measure 40 inches along the curve, but in a specimen killed near Karachi the length was 52½ inches, with a basal girth of 7 inches.

The range of this species is extensive, and was formerly even more so than it is at the present day. There is evidence that in classic times this goat was widely distributed over the Grecian Archipelago, although in Europe it is now found only in Crete, the island of Antimelo in the Cyclades, and perhaps also in Giura, to the north-east of Eubœa. Eastwards it is found in the Caucasus, and the mountains of Asia Minor, being especially common in the Taurus range, whence it extends through Persia into Baluchistan, Sind, and Afghanistan. In India its range does not extend beyond the western side of Sind, as eastwards and north-east of the Bolan Pass and Quetta its place is taken by the markhor. Found in Sind and Baluchistan in hills little above the sea-level, in the mountains of Persia it ascends to elevations of eleven or twelve thousand feet.

The pasang is an extremely active animal, chiefly frequenting craggy and rocky districts, and taking leaps of great length with unerring precision. Although such a feat has been expressly denied by all competent authorities as occurring among sheep, it is recorded by a trustworthy observer that one of these goats, which had missed its footing, saved itself by alighting on its horns.

In Sind and Baluchistan these goats inhabit barren rocky hills, but in parts of Asia Minor they occur on forest-clad uplands. In such localities they may often be found within hearing of the drivers on the roads, or even of the railways, but this confidence is accompanied by exceeding watchfulness. The number in a flock in these districts is from four to ten, and for part of the year bucks and does are found together. Sentinels are almost always posted to warn the flock, these being relieved at short intervals; and it appears that this sentry-duty is undertaken according to seniority, the youngest animals beginning first, and the oldest buck taking his turn last. In Asia Minor pasang are hunted both by driving and by stalking, but they are so cunning that the former method is not generally very successful. The Cabulis hunt them on the lower grounds of Afghanistan with Afghan greyhounds.

In the Caucasus the kids are born in May, but in Sind they are produced probably somewhat earlier. There may be either one or two, and, it is said, occasionally three, at a birth.

The bezoar stone, so highly esteemed in Persia as an antidote to poison and a remedy for several diseases, is a concretion found in the stomach of the pasang, whence it derives its old European name of pazen, or pasen.

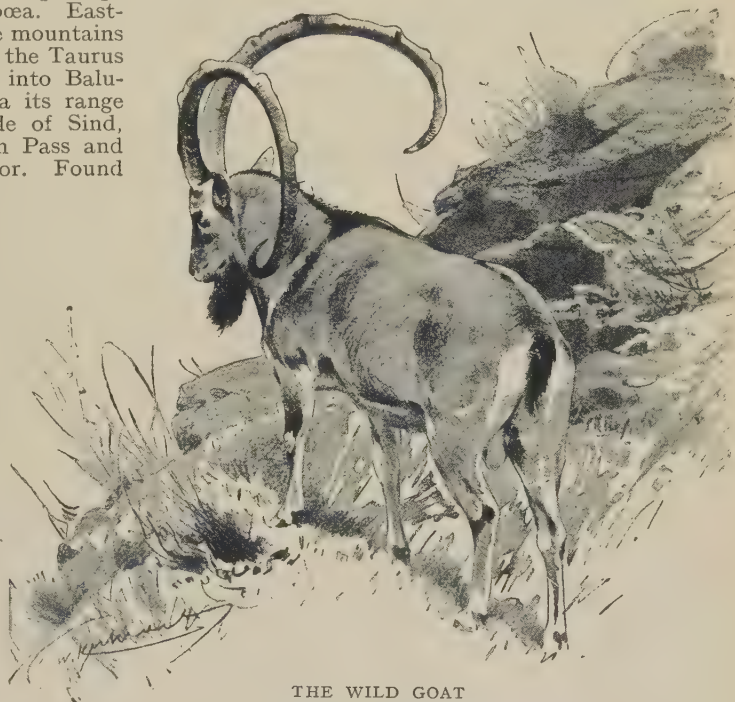
The Sind wild goat is recognised as a distinct race of the species, under the name of *Capra hircus blythi*, and is characterised by the slight development of the knobs on the horns; while the wild goat of the Caucasus forms another local race.

DOMESTICATED GOATS

Though mainly, if not exclusively, derived from the Persian wild goat, it is probable that some of the domesticated breeds may have been crossed with other

wild species. Domesticated goats exhibit great variety in the form of their horns; some retaining the backward scimitar-like sweep of the ancestral pasang, while others assume a spiral form recalling those of the markhor. Generally, however, in such spiral-horned specimens the direction of the twist is precisely the opposite of that which occurs in the markhor, although this is not the case in the Circassian breed.

The breeds of domesticated goats are almost innumerable, and there is such an amount of difference between



THE WILD GOAT

the more extreme types that it is at first sight difficult to believe that they all belong to a single species. In certain instances the horns may disappear from one or both sexes, while in other cases those of the female are quite different from those of the male, and occasionally a second pair may be developed. Equal diversity obtains in regard to the length of the hair, which in the long-legged and pendulous-eared Indian breed is no longer than in a deer, while in the Kashmir and Angora goats it reaches nearly to the ground. The colour, again, may vary from pure white to brownish black, and there are great differences as regards the size and shape of the body. The ears may be either upright or pendent, sometimes attaining an enormous length when in the latter state; and hanging lappets, or wattles, may be developed from the throat.

Goats were domesticated by the prehistoric inhabitants of the Swiss lake dwellings, and were also well known to the ancient Egyptians. Among the more noteworthy breeds, one of the most valued is the Angora goat, a native of a district of Asia Minor, but which has been introduced into several parts of Europe and South Africa, where it is kept in large flocks. It is a large goat, with long, flattened, and spirally twisted horns in the males, and has been regarded as a direct descendant of the markhor. The body is low, the legs are stout, the head and neck short, and the ears pendent. The white hair is long, wavy, and silky, and is used in the manufacture of a particular kind of cloth.

During cold weather these goats are kept in stables, but throughout the rest of the year are suffered to roam at large; the flocks are very large, each buck being accompanied by about a hundred does. They are shorn in April; and during the heat of summer the hair is carefully washed and combed in order to prevent its deterioration. Some few are born without horns, and it is stated that in such cases the hair is short and close.

Of equal celebrity with the last is the Kashmir, or rather Tibetan, shawl-goat, which is a somewhat small but strongly built breed, characterised by the presence of a thick under coat of wool beneath the long hair. The neck is short, the head is somewhat thick, the eyes are small, and the pendent ears longer than half the length of the head. The horns are long and flattened, with a sharp edge in front, and curved outwards and backwards; their tips being inclined inwards. There is considerable variation in colour, but generally the sides of the head, the upper parts of the body, and the tail are silvery or yellowish white. Some individuals are uniformly coloured throughout, and may be either pure white, yellow, light or dark brown, or even black. Although most abundant in Tibet, the Kashmir goat extends to Bokhara and the country of the Kirghiz, while it has been introduced into France, Würtemberg, and Austria. These goats are valued for their under wool, which is combed out during the summer, and is known in Kashmir as "pashm." From this pashm are manufactured the Kashmir shawls, and also a very fine and soft dove-coloured cloth, pashmina. A certain quality of pashm is also obtained from the Himalayan ibex. Enormous flocks of shawl-goats are kept in many parts of Ladak and Tibet.

The Syrian, or mamber, goat of Eastern Europe, South-Western Asia, and Egypt, which takes its name from Mount Mamber, in Palestine, resembles the preceding in the length of the hair, but is distinguished from all other breeds by the extraordinary length of its pendent ears, which may be half as long again as the head. These goats are of large size and very tall, with horns usually present in both sexes, but larger in the males, and of variable shape; the profile of the long face is nearly straight, and both sexes have a small beard. The long, black hair is shaggy and silky. This goat, like the two next breeds, is represented in the old frescoes of Egypt, and is also found mummified.

The Theban, or Egyptian, goat is another breed, agreeing in size with the ordinary domesticated goat, but with longer legs and shorter horns, and especially

distinguished by the small size of the head, the extreme convexity of the profile, and the presence of a pair of lappets or tags on the throat. The horns are frequently absent in both sexes, and when present are short, thick, and crumpled; while there is generally no beard. The pendent ears are about as long as the head, and are rounded at the tips, and flat. The hair is short, and generally of a reddish brown colour, but inclining to yellow on the legs, but sometimes the colour is slaty-grey, or spotted. These goats extend from the countries along the Lower Nile to Central Nubia. The Theban strain of this breed has the most marked convexity of profile.

Perhaps, however, the most remarkable of all the breeds is the dwarf Sudani goat, standing 24 inches or less at the shoulder, and characterised by the short horns of 3 or 4 inches in length, curving at first backwards and outwards, and then bending forwards at their tips. The legs are short and strong, and the short but thick hair is generally dark-coloured, frequently showing a mixture of black and reddish. Sometimes the dark colour is relieved by white spots, but red, yellowish brown, and perfectly black specimens are not uncommon. From the chin depends a black beard reaching to the chest, where it divides to spread over the shoulders and upper part of the fore limbs.

These dwarf goats are found over all the country lying between the White Nile and the Niger, and doubtless extend over the greater part of Central Africa to the West Coast. They are kept by the natives in enormous flocks. The goat of the Caucasus represents a breed with the markhor type of horn, but with the twist in the reverse direction.

Many of the islands of the Grecian Archipelago are inhabited by goats living in a wild condition, which in many cases are probably the product of a cross between domesticated breeds and the wild goat. Goats have also run wild in many other places, more especially mountainous islands like St. Helena, Tavolara near Sardinia, and Juan Fernandez. In St. Helena these wild goats have completely destroyed a large portion of the native flora, and this has resulted in the disappearance of much of the fauna. Goats were introduced by the Spaniards into Juan Fernandez in 1563.

These soon increased enormously, and, in order to diminish their numbers, dogs were let loose and also ran wild. At the time of Lord Anson's visit, in the summer of 1741, the goats had been greatly reduced in numbers by the dogs, and they were further so much thinned by his party that it was estimated that only about two hundred remained. About 1860, while the



THEBAN GOATS

BRITISH DOMESTICATED GOATS

dogs had disappeared, the goats had once more become exceedingly numerous, but in 1885 and afterwards the goats were vigorously hunted by the settlers with guns and dogs. The colour of these goats is reddish brown, in some districts spotted with dirty white. The goats of the mountains of the Azores are distinguished by the length and upright direction of their horns, from which feature they have been called "antelope goats."

Of exceptional interest is the extinct pigmy "rodent goat" (*Myotragus balearicus*) of the Balearic Islands, of which the skeleton was discovered in a cave in Majorca in 1909. This goat differs not only from all members of its kind, but from all other known ruminants in the reduction of its lower front teeth to a single pair of permanently growing, chisel-like incisors, which accord with those of rodents in almost every particular, not even excepting the restriction of the enamel to the lower and outer surface. By what these teeth were opposed in the upper jaw is, unfortunately, not known, as the extremity of the muzzle of the skull is lacking. The peculiarity of the Balearic goat is, however, not restricted to the teeth, for the cannon bones of the feet are remarkable for their extreme shortness and breadth, features in which they excel the corresponding bones of the takin and the Rocky Mountain goat.

At what period this extraordinary goat lived, why it died out, and the reason for its dental and skeletal eccentricities, are questions which cannot at present be answered. Judging from the appearance of the bones, it might be surmised that this ruminant flourished at quite a recent date; but as the condition of cavern remains is untrustworthy as a clue to age, it would be hazardous to draw conclusions with regard to this point.

R. LYDEKKER.

BRITISH DOMESTICATED GOATS

Goats are not so quiet and submissive as sheep are when under domestication, and their habits are more erratic and more independent. Although typically mountain animals, and naturally living in flocks, they do not mind being separated from their fellows, and love, when possible, a roaming life and opportunities of climbing to great heights among rocks. They are very sociable when living with man, and show little fear of their owners.

As regards feeding, goats are very capricious in the selection of their food, and do not graze steadily, as do sheep, on the richer lowland pastures, but prefer

moving about and cropping a variety of herbage as fancy directs them. Moreover, they are very fond of gnawing bark and, when they have a free range, of devouring the tender shoots of shrubs, trees, and hedges. They are, therefore, often looked on as an unmitigated nuisance in highly cultivated districts, especially where much fruit is grown.

For centuries the goat was largely cultivated in the British Isles, but with the extension of sheep and other improvements in agricultural practice the numbers gradually declined, and it is only of recent years that the economic importance of "the poor man's cow"—especially for the working classes, who often are unable to obtain a supply of wholesome milk for their children—has been again recognised. Besides providing a supply of nutritious milk, which

is specially adapted to the requirements of children and invalids other parts of the animal may be used for various purposes: thus in certain countries the hair is clipped from the body and made into coarse cloth for tents and the like; the skin is very valuable for the manufacture of leather, and provides the fine Morocco leather of commerce; the skin of the kid is further in great demand for making gloves of the finest quality.

There is a prejudice in the United Kingdom against using the flesh of the goat for food, and although in the case of older animals the flesh is somewhat strong and tough, yet with the kid, when young, it is as delicate and digestible as lamb.

BREEDS

The goat is very hardy and can stand great vicissitudes of climate, although it is rather susceptible to suffer from exposure to extreme cold.

Extending as it does throughout so many countries and climates, it is not surprising that we find great variations of form and character in the several domestic breeds in different parts of the world. Although horns are generally present, in certain breeds they disappear in one or both sexes. The hair in some cases is long, in others short. The beard in some breeds is very prominent, and in others it is hardly noticeable. The colour also may be any shade from pure white to black, or patches of these two colours, brown sometimes appearing. The size and form of the body may also vary considerably.

As in the case of pigs, the common goats in the United Kingdom have latterly been largely crossed with foreign blood, and the aboriginal breeds are, therefore, being gradually superseded by animals mainly of foreign ancestry.



A DOMESTICATED GOAT FROM THE CAUCASUS

HARMSWORTH NATURAL HISTORY

With regard to the foreign breeds, more care has been bestowed by the breeders in the past to develop their useful qualities than in the case of the British native varieties, and consequently the former are able to introduce many excellent qualities when crossed with British stock, resulting in increase in size, improvement in milking, and other desirable features. The chief breeds or crosses in the British Isles are as follows :

ENGLISH GOAT. This is characterised by a short-haired and thick coat. The colours may be black, white, grey, or of a brownish tint. The points of what is known as the English goat do not seem to be very well fixed, and Welsh and Irish blood are often apparent. Horns and a beard appear in both sexes.

IRISH GOAT. This animal differs from the English in having a long-haired and somewhat shaggy coat. The colours are white or pied, sometimes running into a red. Both male and female possess horns which are large in size, corrugated, and pointed.

The Swiss varieties include :

TOGGENBURG. A hornless variety from the canton of St. Gall, in Switzerland. It is the most appreciated of the Swiss varieties in the United Kingdom, and has been largely used for crossing purposes.

SAANEN. This white, hornless breed is much esteemed for its milking properties.

The chief crosses are :

ANGLO-NUBIAN. This is obtained by crossing with the Nubian, a breed with pendulous ears and short, black, twisted horns. This cross is considered one of the best breeds now in the British Isles. It may be black, white, brown and black, or any mixture of these colours. The hanging ears of the African ancestor are generally apparent.

ANGLO-TOGGENBURG. This is a cross between the Toggenburg and the English.

Anglo-Toggenburg-Nubians and Anglo-Toggenburg-Anglo-Nubians are also to be met with in the United Kingdom.

MILK PRODUCTION

The principal object for which goats are kept in the United Kingdom is for the production of milk, and much attention has been paid to improving the milking powers of the principal varieties. The introduction of classes for milch goats into agricultural shows has had a beneficial effect, and good milking strains are being evolved and careful pail records made.

The chief advantages claimed for goat's milk as compared with that from the cow are : (a) The milk is of better quality, sometimes containing nearly twice as much butter fat, and it is also very digestible ; (b) the goat is practically immune from tuberculosis, and therefore there is no fear of contamination in the milk supply ; (c) the milk is produced under the most cleanly conditions, as the goat does not get fouled with manure as in the case of the cow, and the animal can also be easily washed. The following figures taken from König are of interest, and show the superior quality of goat's milk as compared with human or cow's.

COMPARATIVE FIGURES SHOWING AVERAGE COMPOSITION

	Human	Cow	Goat
Water	87.41	87.17	85.75
Fat	3.78	3.69	4.78
Proteids (flesh-formers)	2.29	3.55	4.29
Milk Sugar... .. .	6.21	4.88	4.46
Mineral Matter	0.31	0.71	0.76
	100.00	100.00	100.00
Total Solids	12.59	12.83	14.29

The milk seems to be of special value for delicate infants, and in some countries babies are fed directly from goats, their mouths being applied to the washed teats so that they are able to suck for themselves. The results obtained by this method seem to be all that can be desired as far as the health and thriving of the children are concerned.

YIELD. A good goat of a milking strain may be expected to yield two quarts a day after the second kidding. A few in the United Kingdom have been known to yield a gallon a day. The yield, of course, gradually diminishes as time goes on, till the nanny is dry. A goat should give sixty gallons in the year,

and an exceptionally good one may do up to one hundred gallons, but this is very rare. In purchasing females it is wise to have a guarantee that they will give at least three pints a day at kidding.

MANAGEMENT

BREEDING. The natural time for goats to breed is once a year, in the spring. With the introduction of foreign blood, however, it is possible to get them to breed at other periods, so that a continuous milk supply can be obtained all the year round. Generally, two kids, though occasionally three or four, are produced at a birth. For purposes of milking, most up-to-date goatkeepers prefer the nannies to stand on a low bench, with their heads in a sort of guillotine.

FEEDING. During stall feeding in winter goats are apt to be wasteful, and hay and other food will be picked over and trampled under foot unless care be taken to prevent it. It must be remembered that a variety in the dietary is essential if we wish to keep goats healthy. In summer, grass in conjunction with cut green fodder and waste from the garden, and perhaps a small feed of oats at milking time, will be sufficient. During winter, hay, rough fodder, roots, and an allowance of corn in the form of oats or bran are the usual feeding stuffs employed.

For the cottager, browsing by the roadside will be found a wholesome and economical means of feeding. Tethering is another method adopted in some quarters, whereby the goat is attached by a collar and chain to an iron peg fixed securely in the ground, and this can be shifted from time to time so as to crop the area evenly.

In the neighbourhood of towns goats are often kept entirely in stables with exercise yards attached, their food, in the form of cut fodder and garden waste, being carried to them. This plan is followed in many cases with most excellent results. Goats are supposed to be able to eat with impunity certain plants poisonous to



PURE-BRED ENGLISH GOAT

THE IBEX

other animals, but it is wise to keep them away from yew, privet berries, rhododendrons, laburnum pods, and laurel, as fatal results have been known when these plants have been consumed in any quantities, especially when withered. Sudden changes in diet should be avoided.

COSTS AND RETURNS. Obviously, goats can be kept for a cheaper rate in summer than in winter. The estimates of several goatkeepers put the cost of keep per week all the year round at from 6d. to 1s., although this may be exceeded in the vicinity of towns, where most of the food has to be purchased.

The following seems to be a fair statement of the yearly cost of keeping and returns that may reasonably be expected from a good goat :

		£	s.	d.
Annual depreciation on goat costing £3, with interest		0	15	0
Keep, 52 weeks @ 1s. a week		2	12	0
Labour and housing		0	15	0
		£4	2	0
INCOME		£	s.	d.
80 gallons of milk @ 1s. 4d. a gallon		5	6	8

Balance as profit, £1 4s. 8d.

VALUE TO SMALL-HOLDER AND COTTAGER. With the increase in the number of small-holdings and the extension of the garden ground attached to cottages, there seems every inducement for an extension of the cultivation of goats. The goat is small in size, and adapts itself very easily to its surroundings, and is not at all particular as regards food, provided it can get sufficient variety. It does not care for grass from a pasture alone, but prefers a mixture of herbage such as is found along the roadside and in odd places, and thus it can profitably be made use of as a scavenger. It will also make use of, and turn to good account, garden refuse which would otherwise be wasted.

Although a prejudice exists in some quarters against the flavour of goat's milk, and people who are not accustomed to its use are suspicious of it at first, where scrupulous cleanliness is observed in its production a taste for the somewhat stringent flavour is soon acquired, and often much appreciated. Moreover, where the richness of its quality is known, and the value of its feeding properties recognised, a higher price can be obtained for it when retailed than for cow's milk.

The goat, therefore, must be looked on rather for the supply of milk for home use, or for sale where a private connection has been worked up locally, than as a meat producer. This being the case, the cultivation of the goat may prove of great value to the working classes in the United Kingdom.

DRYSDALE TURNER

IBEX

Although the Spanish and Sind wild goats are frequently spoken of as ibex, it is preferable to restrict this term to four nearly allied species—namely, the true or Alpine ibex, the Asiatic ibex, the Arabian ibex, and the

Abyssinian ibex, all of which species are characterised by the front surface of their long, scimitar-shaped horns being flattened and ornamented by a number of bold transverse knots or ridges. These horns curve backwards, and diverge regularly, although in some cases their tips have an inward inclination; they are nearly triangular in cross-section, the base of the triangle being formed by the broad front surface, and the apex by the sharp hind edge. In the females the horns are small and placed wider apart at the base, with a nearly oval section, and are marked by parallel wrinkles.

The typical ibex, steinbok, or bouquetin (*Capra ibex*) of the Alps is almost exterminated, although preserved by the Italian Government in one or two valleys on the Piedmont side of Monte Rosa. It is readily distinguished from the Asiatic species by the small size of the beard of the males, which is so short as to be scarcely noticeable. The animal is also of smaller size, and at the present day, at least, its horns are much shorter and have less prominent knobs than those of the Asiatic species. Doubtless, however, the general size of the animal, as well as the length of its horns, has been considerably reduced by the circumscribed area to which it is now confined. Formerly, indeed, the ibex roamed over the Alps of Savoy, Switzerland, and Tirol, but unfortunately there do not appear to be records of the length to which the horns at one time attained. Horns of 44½ and 38½ inches in length have, however, been recorded. The pairing season is in January, and the kids are born at the end of June or beginning of July; but the general habits of this species are practically identical with those of the Asiatic ibex.

The sakin, or Asiatic ibex (*C. sibirica*), differs from the Alpine species in the presence of a profuse beard on the chin of the bucks, and a ridge of coarse dark hair along the back, as well as in its superior size and much longer horns. The hair is coarse and brittle, and in winter is underlain by a thick coat of wool, or pashm, which enables the animal to withstand the intense cold of its native mountains. The horns of the bucks have very large knobs, placed at fairly regular intervals; but these knobs do not indicate the annual stages of growth, which are marked by fine lines on the sides of the horns.

In colour the Asiatic ibex is subject to a considerable amount of seasonal and local variation, and a number of geographical races are now recognised. Generally, in summer the colour is brown, only slightly paler above than below, but in the Himalayan race (*C. sibirica sacin*) the whole of the back is creamy white, while the Baltistan race (*C. s. wardi*) has a large whitish saddle on

the back, and a smaller light patch in front of the withers. The dark line on the back has been already mentioned, and, in addition to this, the beard, tail, and legs are also dark brown.

A well-grown buck of the Asiatic ibex will stand about 40 inches at the shoulder, while does are about a third smaller. Good horns measure from 40 to 45 inches along the curve, but specimens of 56 and just over 57 inches are known, and a length of 54 inches is not very rare, most of such fine examples coming from the Tian Shan.



PURE BRED TOGGENBURG GOAT

Inclusive of its various local races, the species has a very extensive geographical range, being found in all the mountain ranges of Central Asia, from the Himalaya to the Altai, and from the neighbourhood of Herat, on the Persian frontier, in the north-west, to Kumaon in the south-east. It is found not only on the crags but also on the open Pamir country. To the south of the valley of Kashmir ibex are unknown in the Pir Panjal range and its continuation to the north-west of the Jhelam river, the Kajrag, and are not known to occur in the Himalaya to the east of the sources of the Ganges, while they have not been recorded from Eastern Tibet, although there is some reason to believe that they occur in Tibet to the north of Shikatsé, on the Tsan-po river, and also near Lhasa.

Like its Alpine cousin, the Asiatic ibex inhabits the crags and upland meadows at or near the snow-level, rising or descending according to the season of the year.

Although excessively wary, the Asiatic ibex, on account of the broken nature of the ground it frequents, is not very difficult to approach within shooting distance. From personal observation and the accounts of the natives of the valleys round Kashmir, I believe that Asiatic ibex descend in winter to lower levels than is generally admitted, and I have been told that in the valleys of Wardwan and Tilel numbers are killed at this season in the snow quite close to the villages. On one occasion in summer I saw a small flock of ibex driven from the heights by a sudden snowstorm to the level of the high road between Kashmir and Ladak, in the valley of the Indus.

In 1854 Colonel Markham wrote that in Kashmir ibex might be seen in flocks of a hundred or more, but nothing like these numbers are found at the present day, and in the immediate neighbourhood of Kashmir the number of these magnificent wild goats has been greatly reduced.

The bucks descend from the higher crags to join the does about October, the pairing season being the winter; the young are born in May and June, or about a month earlier than is the case in the Alpine species. To the natives of Kashmir the ibex is known as the *kel*, while in Baltistan and Ladak it is termed *skin*, or *iskin*.

The third representative of the group is the Nubian or Arabian ibex (*C. sinaitica*), locally known as the *beden*, which inhabits the Sinaitic Peninsula, portions of Palestine, and Upper Egypt, and is common in Arabia Petraea, but more rare in Palestine proper, and never appears to have extended northwards of the Lebanon, where a few still remain. In Egypt its southern limit is approximately marked by the Tropic of Capricorn. This species is distinguished from the Asiatic ibex by the horns being more compressed, with the outer angle of the front surface much bevelled away. The general colour of the coat is yellowish brown, with dark markings on the back, chest, and front of the legs, the under parts and the hind surface of the limbs being whitish. In well-grown adult males the horns may attain a length of 50 inches along the curve.

Lastly, there is the wala, or Abyssinian

ibex (*C. vali*), from the Simien district of Abyssinia, a very large dark-coloured species, with massive black horns of the general type of those of the Arabian ibex, but much broader and carrying less prominent knobs. A peculiarity of this species is the presence of a prominence on the forehead of the skull. Although described in 1835, this splendid ibex was not known in English museums till 1907.

THE MARKHOR

The Himalayan markhor (literally "snake-eater"), or spiral-horned goat (*Capra falconeri*), is the last representative of the genus *Capra*, and distinguished from all the others by its upwardly directed and spirally twisted horns, and also by the extension of the beard on to the chest and shoulders (page 676). In the latter respect this species recalls the udad among the sheep, although the markhor agrees with other goats in the shortness of its tail.

Markhor are further remarkable for the enormous amount of variation in the form and size of the horns; one race having them twisted in the form of a corkscrew, with not more than one and a half complete turns, while in another they are twisted on their own axis in the form of a screw, which may have as many as three complete turns.

These races were formerly regarded as constituting distinct species, but since they are more or less completely connected by intermediate forms, they are evidently nothing more than the extreme developments



IBEX AT HOME

THE MARKHOR

of one very variable species. The horns of the races with a corkscrew-like twist are the finest trophies yielded by any of the goats.

In Kashmir or Astor a male markhor may stand nearly 3 feet 8 inches at the withers, although an adult Gilgit specimen measured only 3 feet 2½ inches. The magnificent beard, extending in the adult males on to the chest and shoulders, and sometimes reaching nearly to the knees, is black in front and grey behind; in young bucks and does at all ages it is confined to the chin.

The fur has little or no pashm, and in summer is of a reddish brown colour, but becomes grey in winter; it is paler on the under parts, and the lower portions of the front of the legs have a dark stripe.

In summer the very old males become whitish all over, but the young are uniformly greyish brown, except for a dark stripe along the back. Owing to the variation in the different races, it is somewhat difficult to give a description of the horns which will hold good for all. They are, however, much compressed, placed close together at the base, and spirally twisted, with a keel both in front and behind. The front keel, which tends to become rounded in old animals, at first turns outwards in each horn, and the sharp back keel twists forwards to form the prominent front ridge of the first turn of the spiral. The length varies greatly in the different races. The females have small horns with a slight twist.

The markhor is first met with in the Pir Panjal range, forming the outer boundary of the valley of Kashmir, but does not extend to the east of the valley of the Chinab river. To the north and north-east of the valley of Kashmir it reaches into the districts of Baltistan, Astor, and Gilgit; and it is also found in many of the ranges of Hazara and Afghanistan, as well as in the neighbourhood of Quetta.

At least four distinct races of the markhor are recognisable, which may be characterised as follows: Firstly, there is the typical Astor and Baltistan markhor, in which the horns form a very open spiral, never containing more than one and a half turns. These horns are extremely massive, and attain a great length, specimens being known which measure 60 and 56 inches in length along the posterior keel, and it is probable that an example with a length of 63 inches belonged to this race. Next we have the Pir Panjal markhor, in which the spiral is less open, and may form from one to two complete turns. This race extends across the Jhelam river into the Kajnag range, and thence probably into Hazara and Gilgit, where it passes into the third race. Horns measuring 56, 59, and even 63 inches along the curve have been recorded. In the third or Kabul variety the horns are almost straight, but still have a slight spiral, with two complete twists. Specimens have been measured with a length of 35 to 41 inches in a straight line, the curve measurement being, of course, considerably greater.

Lastly, the markhor of the Suliman range, on the eastern frontier of Afghanistan, is characterised by the horns being generally perfectly straight; with the front and back keels wound round in a sharp spiral, which may form from two to three and a half complete turns. In the largest recorded horn the length in a

straight line is 48½ inches. This race is considerably inferior in size to the others, and has a smaller beard.

The different races of the markhor exhibit some diversity in their habits, owing to the varying nature of their native districts, the open-horned races inhabiting lofty pine-clad ranges, whose summits are wreathed in snow-while the straight, horned Suliman race has its home among barren and rocky hills of trifling elevation, where the heat during summer is frequently intense.

The markhor of Kashmir and Astor frequent forest-clad mountains, but in Afghanistan these goats inhabit bare and rugged hillsides, owing to the absence of forest in that country. The ground haunted by markhor in many parts of Kashmir territory is of the most loose and rotten description, which renders stalking decidedly dangerous. Not infrequently markhor are found with one or both horns much broken, but whether this is due to accidents from landslips and avalanches, or to combats between one another, does not appear to be ascertained.

The Suliman markhor is frequently found at a comparatively low elevation, and in all localities this goat does not bear extreme cold so bravely as its cousin the ibex, always descending in winter to the more protected valleys. This sensitiveness to cold is doubtless due to the absence of under fur, or pashm.

In captivity markhor breed freely, the number of young at a birth being either one or two. It does not appear to be ascertained when the young are born in the Pir Panjal range, but in the districts of Astor and Gilgit they are produced in May and June. Markhor have frequently interbred with domesticated goats, and it was formerly considered that the spiral-horned varieties of the latter traced their parentage directly to this species.

In domesticated goats, as already mentioned, the horns are almost invariably twisted in the opposite direction to those of the markhor, although there are occasionally exceptions, and in the Circassian breed the twist is always of the markhor type. It is not improbable that some races of domesticated goats may have a larger or smaller proportion of markhor blood.

The markhor is one of the oldest types of wild goat, since a fossil species, which cannot at present be satisfactorily distinguished from the living one, occurs in the Pliocene rocks of the Siwalik Hills at the foot of the Himalaya.

R. LYDEKKER

IN PURSUIT OF THE WILD GOAT

BY MAJOR F. G. ALEXANDER

In 1876, in the month of May, I was one of the officers who accompanied Sir Robert Sandeman on his mission to Baluchistan. When we arrived at Beebi Nani, another officer and myself made arrangements for a big drive after wild goats and sheep. Eighty Brahuis, armed with matchlocks, formed the attacking and beating force.

After many anxious moments while climbing, I found myself on a ridge about 4,500 feet above sea-level. A long stretch of mountain cliff was below, and



HEAD OF TIAN SHAN IBEX

my brother officer was at some distance from me. I think I can safely say that one hundred beasts were at one time on the move, advancing towards my position ; but as they approached they appeared to melt away, though I killed three markhor that had bobbed up from time to time near me. After the beat we descended to the ravine, and I learned that the beaters had shot nine markhor and urial, some of them very fine specimens.

Alladina, once the robber chief of the Bolan Pass, was responsible for the organisation of the beat, and I asked him whither the vast flock I had seen had gone. His answer was brief—"Caves."

I have stalked the Persian wild goats—or Suliman ibex, as they are often styled—and have driven them, and more cunning beasts are difficult to find. Knowing their hiding proclivities, and having learnt a little from expert Sind hunters, I afterwards had a big beat below the Moola Pass.

There were on that occasion one hundred beaters encircling a vast amphitheatre. I armed myself with an express and a long-range military rifle loaded with detonating bullets. I watched the goats as they scuttled round the vast arena, and from time to time, as the flock diminished, I saw with my glasses some of the flock dive into caves and others settle under shelving rocks.

After all, I prefer stalking, but it is absolutely necessary to get above the goats before sunrise, which often necessitates a two-hours' scramble in the dark to gain the necessary position. Climbing in Sind is very dangerous, moving shale and loose rocks being sometimes disastrous even to the goat.

One day when I arrived at the top of a mountain with two Brahuis, I sat down and waited for instructions. On the opposite side of the valley, about a mile off, other Brahuis were, by arrangement, on the watch. I was told to keep clear of the cliff, take my breakfast, and smoke. The two shikarees, with their bare heads, peeped over a rock ; for some time they were as motionless as marble statues. As I was smoking I saw them both suddenly lower their heads and crawl towards me. One man said : "Forty goats are grazing below ; they may move up or lie in caves. But stay where you are till further notice." The men then crept back to the edge of the cliff.

Time passed heavily, and I began to be impatient, but still I trusted my men. One hour passed, and at last came a final message : "All the goats are in caves or under ledges excepting one, which is moving up towards us." It is a fine beast, and will probably be

within one hundred yards in half an hour, as there is stuff which goats like to eat below us."

The goat drew near, and I shot it, but not mortally. Away it went across the valley out of sight, and I thought I had disgraced myself before the Brahui shikarees. Young as I was, I was very keen about my reputation as a shot.

The Brahuis a mile off were still there, and I heard an animated conversation which I did not at the time comprehend ; but the two men by me and four men a mile off were talking and understanding what they shouted. Marvellous it is how hillmen can converse at a distance in the clear mountain air, and possibly the power they possess will explain why the murder of Sir Louis Cavagnari and Hamilton at the Kabul Residency in 1879 was known in the Peshawur Bazaar long before

Simla received the tidings. From hill-top to hill-top news is conveyed from Kabul to Peshawur by verbal telegraphy.

The distant Brahuis notified that the wounded goat was lying under a rock below them, and that I should move round the hills, which necessitated a very long walk of two miles over rugged rocks, to reach the spot. I must confess that when I stood over the cave containing the goat I was extremely nervous. I felt that if the beast got away no Brahui would worry about helping me to slay the sly goat again, and I was thankful that I did kill it as it bolted.

It is well known that the markhor confines its peregrinations to the north-east of the Bolan Pass. I have watched big markhor on the Tukatoo Mountain, which is close to Quetta, and have also been all round Chaitarn, south of Tukatoo, but no markhor were there. The urial is a beast which is found in company both with ibex and markhor, and the urial is not cave-seeking like them.

Whilst fishing for mahseer in the Moola Pass in September, 1876, I frequently saw ibex at some distance drinking by the river, as a rule in the early morning or late in the evening, but twice

I saw them in the valley at midday. Unfortunately, I could not follow them, as my orders were not to leave the pass. At that time Baluchistan was dangerous for travellers, and even I had an escort of eight guides. A survey officer told me that there are more goats near the sea west of Karachi than in any other part of the Suliman range.

It is necessary for a European when scaling the hills of Baluchistan to wear goat-skin sandals as worn by the Brahuis. It is impossible to move with any safety in ordinary boots.

F. G. ALEXANDER



SULIMAN MARKHOR

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